AN ANALYSIS OF THAILAND'S PROCESSED FOOD GLOBAL VALUE CHAINS

A thesis
submitted in partial fulfilment
of the requirements for the Degree of
Doctor of Philosophy in Agribusiness

at
Lincoln University
by
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Lincoln University
2020

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Thailand is a key producer and exporter in global value chains of processed food that needs to comply with multiple global product standards and requirements. The Thai processed food industry needs to continuously upgrade its production processes to meet those standards and requirements. However, it is not simple to decide which upgrading processes are suitable for the industry, it depends on many factors, such as product characteristics and governance forms in each value chain. Understanding how Thailand's processed food value chain operates and how to upgrade it is, therefore, essential both to maintain the country's position in the value chains and the industry's export competitiveness.

This study explores the governance structure in the Thai processed food sector. The study uses the gravity model estimated by several econometric methods to examine the impacts of economic (product, process, and functional) and social upgrading on Thai processed food exports from 1998 to 2016. The study identifies important determinants influencing the economic and social upgrading of the sector using the ordinary least square estimation.

The findings show that captive and hierarchical forms of governance explain Thailand's processed shrimp and chicken value chains since their production processes are strictly controlled by food safety standards. Economic transactions in the Thai canned tuna industry illustrate captive, hierarchical forms of governance. The Thai canned pineapple value chain, in contrast, depends on market governance. Canned pineapple is produced in simple forms and does not have to meet as much food safety standards as processed shrimp and chicken. Hence, most economic transactions in the canned pineapple industry depend on product prices.

The results suggest that all upgrading types are statistically significant in Thai processed food exports to developed countries. Conversely, most upgrading types are insignificant for exports to developing countries. Interestingly, process upgrading has a negative effect on exports currently because of

increased production costs to comply with product standards. However, process upgrading can lead to an increase in producers'/exporters' knowledge about how to comply with international standards. Accordingly, process upgrading exhibits a lagged positive impact on processed food exports.

The results also suggest that economic and social upgrading are significant in the export of processed foods that are in a sophisticated form, such as processed shrimp and processed chicken, especially on food safety issues and stringent quality. However, economic and social upgrading are likely to be insignificant in exports of products that rely less on food safety standards and are in simple forms with clear international standards (canned pineapple).

When focused on the crucial determinants influencing economic and social upgrading of the Thai processed food industry, the findings are mixed. For example, human development, political stability, and industry institutionalisation are positively significant for product upgrading. In contrast, human development, port infrastructure development, political stability, and industry institutionalisation are positively significant for process upgrading. All this suggests that each upgrading type requires different supporting policies, there is no 'one-size-fits-all' policy.

Keywords: Global value chains, Governance and upgrading, Export competitiveness, Thai processed food exports, Gravity models

Acknowledgements

The completion of this thesis would not have been possible without great and valuable help and support of the following people and organisations.

Firstly, I feel deeply grateful to my beloved advisors, Assoc. Prof. Baiding Hu and Prof. Christopher Gan, my main and associate supervisor, respectively. Their knowledge, support, encouragement, valuable comments and suggestions, including their endless patience throughout my PhD journey at Lincoln University significantly contributed to the writing of my thesis.

Secondly, I am thankful to Department of Agricultural and Resource Economics, Faculty of Economics, Kasetsart University, in permitting my study leave to complete my PhD and for providing me with financial support during the study. My thanks are extended to the staff of the Department of Agricultural and Resource Economics, Faculty of Economics, and Kasetsart University facilitating things for me in terms of relevant documents and processes for my study leave.

I also express appreciation to Assist. Prof. Visit Limsombunchai and Assist. Prof. Nuchanata Mungkung who gave me valuable suggestions and information for study at Lincoln University. In addition, I am thankful to my colleagues at Kasetsart University, Thammasat University, and other educational institutes, Dr. Atchara Patoomnakul, Assist. Prof. Nuttapon Photchanaprasert, Assist. Prof. Kulapa Kuldilok, Assist. Prof. Apichat Daloonpate, Dr. Hongsilp Sriket, Pit Jongwattnakul, Assist. Prof. Sutana Boonlua and others, who shared some knowledge for my thesis.

I am specially thankful to my beloved peers, LU students and non-LU students, for sharing their academic opinions and their assistance in many ways. In particular, my special thanks goes to Tidarat Kumkit, who always provided valuable suggestions and information and great support throughout my PhD study, especially when I had problems. I am also thankful to Yingluck Moonsan and her family (Preecha, Boss, and Best), who have been my lovely flatmates during my study time. They always make me feel comfortable and happy when I stay with them. My special thanks are extended to some of my peers for their support, sharing great ideas, and having good times together in New Zealand. They are P'Pla, P'Aun, P'Aon, P'Lek, P'Mon, P'Mag, P'Bobby, P'Pu, P'Khwan, P'Note, P'Tip and Julian, P'Pol, P'Giff, P'Nui, Dear, Nack and Bam, Nun, Mai, Pond, Bumbim, Gam, Zara, Ake, Eye, Linh, Ken's family, Fauzan's family, Sophanith, Yuthea, Srun, Sokna, Kongchheng, James Berry, Hashika, Khanh, Alex, and other peers who worked in the postgraduate room and Orchard Hall.

My thanks are extended to the staff of English Academic Programme (EAP) and Lincoln University for their great support during my PhD study. In particular, I am thankful to Daryl Streat, Patrick Coleman, Ann Reeves, who helped me to significantly improve my English skills and shared some social

experiences, especially living in New Zealand, when I attended EAP in 2016. All the knowledge and experience that I gained from them helped me to complete my thesis writing. My sincere gratitude goes to Caitriona Cameron, Craig Nicholson, Stacey Boniface, and other LTL staff who provide excellent support in terms of thesis writing during my thesis progress. I give thanks to English editors of my thesis, Eric Scott, Addison Ramzi, and Rebecca Kambuta, who edited English grammar throughout my thesis. I also express my appreciation to the LU Recreation Centre staff, especially Graeme Campbell, who provides excellent support for the LU football club.

I do really appreciate my beloved clubs: the Buddhist Society and LU football clubs, for always giving excellent social time during my study at Lincoln University. All members of the clubs made me feel pretty happy when I feel tired from writing my thesis. Playing football every Tuesday, Thursday and Saturday with members of LU football club helped me reduce my stress. The Wednesday meditation class and Dharma talks by Neil Ritson helped me to learn and concentrate on my thesis. In particular, I give special thanks to Neil Ritson, who is one of the great Kalyanamittham in my life.

Last but not least, I am especially thankful to my lovely inspiration, Aranee Thongcharoensukchai, for all her great, sincere support whenever I felt tired, unsuccessful, depressed or unhappy. I am highly grateful for the brilliant encouragement which always enhanced my strength and lightened up my world to be able to complete my thesis successfully.

Finally, I would like to dedicate this thesis to my family, especially my father, my mother, my beloved brother, who always stand by my side no matter what good or bad things happen.

For any deficiencies, ambiguities, and errors that probably contained in this thesis, these are the sole responsibility of the author.

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Chapter 1

Introduction

1.1 Introduction

International trade has evolved over the past few decades. In particular, from the mid-1980s, most countries shifted from using an Import Substitution strategy (IS) to Export Promotion strategy (EP). This change of strategy led to international expansion and geographical fragmentation of contemporary value chains. Countries that participate in these value chains can harness the benefits associated with them (Gereffi & Lee, 2012; Kohpaiboon, 2006). Both developed and developing countries have therefore attempted to seek greater opportunities to participate in these global value chains to gain greater benefits from the world market (Gereffi et al., 2001). Significant examples can be found in East Asia and Latin America. Many multinational companies, especially those from developed countries (i.e. the U.S. and Japan) have increased their investment in these regions to establish new production bases for exports because they can lower their production costs. Multinational companies have injected an abundance of foreign direct investment (FDI) and new technology into these regions (Athukorala, 1998; Kohpaiboon, 2006). Additionally, the companies control the production processes[1] to produce high-quality products. The products can respond to changes in consumer demand, especially in developed countries that are key importers in the world market (Athukorala et al., 2002; Athukorala & Jayasuriya, 2003).

Global value chains (henceforth GVCs) provide a framework for understanding new patterns of global trade. The primary purpose of GVCs is to deliver products from the upstream to the downstream with the collaboration of all stakeholders within the chain for global optimisation. For example, developed nations that are key buyers in global markets can purchase quality products with lower prices by importing products from overseas countries. Conversely, developing nations that usually play a key role as producers in the global market can expand their exports (The Office of Industrial Economics, 2015).

GVCs have two important components: *governance and upgrading* (Gereffi et al., 2005; Gereffi & Lee, 2012). The first component, governance, refers to the non-market coordination of economic activities. The governance component emphasises a firm's competency, called the *leading firm*, to determine the production activities of other firms, the *suppliers*, in the GVCs. According to the literature, there are five fundamental types of governance: market, modular, relational, captive and hierarchical.

[1] The company controls the production processes through the supply chain using many types of governance (Gereffi, 1999; Gereffi et al., 2005; Humphrey & Schmitz, 2002; Ponte & Sturgeon, 2014).

Simplifying types depends upon three key determinants: the complexity of the transactions, the ability to codify transactions, and the capability of suppliers (Gereffi, 2011; Gereffi et al., 2005) (see Table 1-1). The first of these, complexity of transactions, refers to the level of difficulty regarding the information and knowledge required in the value chain, especially with respect to product standards and production processes. If there are many specific requirements relating to product standards and particular production processes, the transaction is considered highly complex. The ability to codify the transaction refers to information and knowledge related to the transaction and whether it can be easily codified or whether the transaction needs specific investment or requires high levels of interaction between the leading firm and the suppliers. The capability of suppliers refers to the level of supplier competence and whether the suppliers comply with the information and knowledge required in the value chain. If suppliers comply easily with product standards proposed by the leading firm, it means that they have high competency. For example, market relation refers to the condition where there are simple product standards that are easy to codify. The transaction between the leading firm and suppliers is, in this case, considered "low complex". In addition, the suppliers must have high competency to comply with the product standards proposed by the leading firm. Switching costs between the leading firm and suppliers seeking to find new partners is low. Further, product prices will become a key instrument to make the connection between the leading firm and suppliers (Gereffi et al., 2005). In contrast, the hierarchical relationship (sometimes called vertical integration), occurs when the transaction between the leading firm and suppliers is highly complex and difficult to codify. These suppliers lack competency. Consequently, the leading firm has to control the production processes throughout the value chain to ensure that it produces high quality products (Hamilton-Hart & Stringer, 2016; Humphrey & Schmitz, 2002; Ponte & Sturgeon, 2014).

Upgrading GVCs relates to economic activities that encourage firms or countries to shift from low-valued activities, such as producing simple parts of products, to high-valued activities, such as brand designing or producing sophisticated products.[2] It can also be used to describe the process where firms/countries are able to maintain their position in GVCs. Two key types of upgrading are used to explain the form upgrading takes in GVCs. These are economic and social upgrading. Economic upgrading can be separated into four sub-types: product, process, functional and inter-sectoral upgrading. Product upgrading refers to the fact that producers can produce sophisticated products. Process upgrading refers to transforming input factors, such as production resources (e.g., labour, capital, and technology) to outputs more efficiently through reorganisation of relevant production activities. Functional upgrading describes a condition where producers can achieve new functions in the GVCs, such as moving from assembly actors to distributors. Inter-sectoral upgrading refers to the practice where producers leverage knowledge acquired from a current chain to expand their business

[2] For example, firms can produce high degrees of product differentiation, such as adding a variety of product flavours.

into a new industry. The other main type, social upgrading, relates to improvement areas involved with labour, such as wages and employment conditions (Barrientos et al., 2011; Bernhardt & Milberg, 2011a; Werner et al., 2014).

Table 1-1 A Comparison of Governance Types

Governance Type	Complexity of Transactions	Ability to Codify Transactions	Capability of Suppliers
Markets	Low	Easy	High
Modular	High	Easy	High
Relational	High	Difficult	High
Captive	High	Easy	Low
Hierarchy	High	Difficult	Low

Source: Adapted from Gereffi et al. (2005)

The GVCs approach connects developing and developed countries in global trade (Balié et al., 2018; Gereffi & Fernandez-Stark, 2011). Developed countries, such as the U.S., countries in the European Union (the EU) and Japan, have played important roles as key importers or end-markets of a wide range of products. Conversely, developing countries, such as Thailand, Chile and Indonesia, have acted as the main exporters or producers of a great many products, especially those that require large work forces, such as processed food (Athukorala & Sen, 1998; Banga, 2014; Jongwanich, 2009). Generally, developed countries acting as leading firms employ various forms of governance to control production processes in developing countries that are selected as a production base for exports. Developing countries, which act as key producers in the world market, need to maintain or increase their positions in the GVCs to gain the associated benefits. This practice is called upgrading (Gereffi et al., 2005; Gereffi & Lee, 2012; Humphrey & Schmitz, 2002). Some studies show that participation in GVCs enhances a country's development. In particular, cooperation within the chain leads not only to increased export growth but also to reduced poverty levels (Humphrey & Memedovic, 2006; The Office of Industrial Economics, 2015).

The concept of the GVCs is widespread in most productive sectors. This results in changes to export composition, particularly in the agricultural sector (Kohpaiboon, 2006). Processed food exported to developed-countries markets has emerged as a potentially major new source of dynamic export growth for many developing countries. Processed food can be divided into two categories: food that is minimally processed and manufactured food, which has undergone significant changes. The first term refers to goods that resemble their original state or have undergone only minimal processing (e.g., yoghurt, dairy products). Manufactured food refers to products that have undergone significant changes, e.g., bakery products (Jongwanich & Magtibay-Ramos, 2009). The relative importance of

classical export commodities traded mostly in raw form (e.g., coffee, tea, sugar, and cocoa), have been eroded and replaced by more processed food exports, such as canned food[3] (Athukorala & Jayasuriya, 2003). Athukorala et al. (2002) note that the remarkable growth in the export of processed food is because of demand and supply factors. The demand side includes the internationalisation of food habits or the increased importance of imported processed food in the consumption patterns of developed countries as well as large sections of the populations of many developing countries. Factors such as international migration, the communication revolution and international tourism also contribute to this phenomenon. This significant demand-side impetus is supported by important supply-side developments, such as improvements in food technology, refrigeration facilities, transport and infrastructure that make processed food items easily tradable across national boundaries. Athukorala et al. (2002) provide some evidence of new export opportunities in processed food. First, export diversification of this commodity category generates significant trade gains. Secondly, the final stages of processing appear to be labour-intensive. This implies that the expansion of the processed food sector has a strong positive effect on employment in typical labour-surplus developing economies.

1.2 Research Statement

Although processed food exports have become a rising star in international trade, a sizeable literature indicates that developing-country exporters have been confronting new characteristics in world demand (Greenville & Kawasaki, 2018). Large retailers, marketers, and brand name firms that have played important roles as key governors of chains, *"Buyer-driven chains"*[4], have raised important standards (e.g., food safety and labour standards) to control the production processes for processed food traded on world markets (Andersson, 2019; Humphrey & Schmitz, 2002; Gereffi, 1999; Gereffi et al., 2005). For example, developed countries that are global buyers now employ food safety standards, Sanitary and Phytosanitary standards (SPS) and Good Agricultural Practices (GAP), to ensure product quality (Tallontire et al., 2011; Tran et al., 2013). In addition, developed countries have recently become concerned about labour problems related to processed food production, such as illegal workforces, labour exploitation and human trafficking, which have emerged in developing countries (Gereffi & Lee, 2012; The Office of Industrial Economics, 2015; Regmi, 2001; Unnevehr, 2000). These new safety and labour standards have become important challenges for some developing countries

[3] This study focuses on both forms of processed food: food that is minimally processed and manufactured food that has undergone significant change.

[4] The general governance of GVCs is divided into two key chains: *Buyer-Driven* and *Producer-Driven Chains.* The first type emerged in the production sector and is related to the labour-intensive sector, namely agri-food. With regard to this chain, large retailers in developing countries who normally act as leading firms concentrate on high product quality. This is particularly true in terms of suppliers' food safety standards. The second chain type refers to the capital-intensive sector, namely parts and components. Large manufacturers (in developed countries) that normally act as leading firms control production processes via the establishment of production plants in developing countries (Gereffi, 1999; Gereffi et al., 2005; Humphrey & Schmitz, 2002; The Office of Industrial Economics, 2015).

(e.g., Thailand, Chile and Indonesia) that produce most of the processed food traded in world markets. They must comply with the new standards to maintain their position in the GVCs (Gereffi & Lee, 2012; Greenville & Kawasaki, 2018; The Office of Industrial Economics, 2015). However, to meet the health and safety requirements and challenges, exporters in developing countries need to spend a great deal of capital and knowledge to upgrade their production processes. If developing countries can comply with the various product standards proposed by global buyers, those countries can expand their exports into global markets and increase their employment levels. Conversely, if countries fail to overcome the challenges proposed by global buyers, their exports will collapse (Barrientos et al., 2011; Fernandez-Strake et al., 2012).

Previous studies acknowledge that to be successful in GVCs, countries need to upgrade themselves (Ponte & Ewert, 2009; Tran et al., 2013). However, not all upgrading types are appropriate nor correspond to all types of governance; some upgrading types are suitable for some governance forms. For example, if the value chain is dominated by the captive form, i.e., a leading firm controls most of the production activities. In this case, suppliers can produce only simple product parts. Accordingly, suppliers are not usually allowed to move from their functions to other functions within the chain (functional upgrading) (Jespersen et al., 2014). Moreover, upgrading is not automatic, even though countries are part of GVCs. Upgrading needs appropriate support, such as research and development (R&D), human resource development (HRD), better infrastructure and financial support. For example, Jongwanich (2009) and OECD et al. (2014) note that R&D and easy access to financial support is important to the development and upgrading of the processed food sector. This is because, to meet and comply with various food standards, R&D and financial support are required.

The success of participation in GVCs contributes to a nation's development, especially for developing countries (Greenville & Kawasaki, 2018). For example, Bangladesh has been a key provider of clothing and apparel because of its labour-cost advantages. Its place in the apparel GVC has led to increased employment levels. Additionally, Bangladeshi's world market share and export value has increased following its participation in the GVCs (Moazzem & Sehrin, 2016). The coffee industry is another example. Many countries in Central America, such as Guatemala and Honduras that are key coffee producers in the GVCs, can absorb technology and knowledge from the GVCs to produce and upgrade their coffee production. After upgrading production, their coffee products are classified as premium coffee. This leads to an increased export values of the product. The export growth of Guatemalan coffee increased from 20% in the 1980s to about 80% in 2015 (Gereffi, 2015). Conversely, in 1997 the EU banned Bangladeshi aquaculture goods because it was concerned about risky deficiencies in the infrastructure and hygiene. This led to increased risk related to public health (such as microbial contamination). An investigation was extended to other key markets. Bangladeshi aquaculture products were detained automatically in the U.S. All shipments of aquaculture goods from Bangladesh

were tested and allowed to enter only if they met U.S. food safety standards (Cato & Santos, 1998; Unnevehr, 2000).

Thailand was a relatively early entrant to the processed food export trade. Following rapid growth in exports for over three decades, Thailand has become a key exporter of processed food (The Office of Industrial Economics, 2015). Thailand has tripled its share of processed food exports since the early 1970s, to over 60% of Thai agri-food exports in the 2000s (Athukorala et al., 2002). Today, Thailand is by far the leading exporter of some processed foods with prominent market shares in the world trade system (Kasikorn Research Centre, 2016a). For example, during 2000-2016 Thai processed shrimps (HS030613 and HS160520) achieved noticeable world market share of approximately 18.1% of world exports of processed shrimps. Similarly, exports of canned food have expanded rapidly over the past two decades. The market share of canned tuna (HS160414) and canned pineapple (HS200820) in the total world exports have been over 40% since the 2000s. Thailand has also played an essential role as a key exporter of processed chicken (HS160232). Thailand's share of processed chicken markets has continuously increased between 2000 and 2016, from 19.4% during 2000-2005 to 29.3% during 2012-2016 (Global Trade Atlas, 2017; UN Comtrade, 2017) (see Table 1-2).

Although Thailand has become a leading exporter in processed food world market, the country must continue to meet buyers' standards and requirements (The Office of Industrial Economics, 2015). The various forms of governance, such as captive and hierarchy (Hamilton et al., 2011; Heft-Neal et al., 2008; Jespersen et al., 2014) depend on many factors, such as product characteristics and producers' capabilities in each value chain. If Thailand can comply and overcome such barriers, its export of goods will be successful and sustainable. Conversely, if it fails to comply with the stipulated standards and requirements that emerge, export competitiveness will be lost. For example, Thailand suffered from an outbreak of the avian influenza (bird flu) between 2004 and 2006. Thailand's unprocessed frozen chicken products could not be sold in the global markets. However, Thailand successfully resolved this problem a year later. To avoid and overcome the barrier of food safety, Thailand began to export processed chicken instead of the unprocessed chicken. This change encouraged the growth of export processed chicken (Krungsri Research, 2016). Similarly, Thailand's processed shrimp production was affected by shrimp early mortality syndrome (EMS) from 2012 to 2014. Suspicions were raised about Thailand food safety by global buyers (Kasikorn Research Centre, 2016a; The Office of Industrial Economics, 2015). As a result, Thailand's market share of the processed shrimp market dropped and there are now other competitors, such as India, Vietnam and China. Thailand's market share reduced from 23.6% during 2006-2011 to 11.1% during 2012-2016 (Global Trade Atlas, 2017; UN Comtrade, 2017) (see Table 1-2). Likewise, Thai canned tuna industry was affected by increasing importance of the labour standards in the world market. Most countries pay more attention to labour practices and problems. Nevertheless, Thai canned tuna industry faced this labour problem (Campling et al., 2007;

The Office of Industrial Economics, 2015). As a result, the world market share of Thai canned tuna dropped from 43.99% during 2006-2011 to 39.75% during 2012-2016.

Table 1-2 World Market Shares of the Top-10 Major Exporting Countries in Processed Foods

Product	The Market Share of Top-10 Major Export Countries					
Processed Shrimp	2000-2005	%	2006-2011	%	2012-2016	%
	Thailand	19.58	Thailand	23.57	India	15.12
	India	8.86	Vietnam	15.14	Vietnam	11..16
	Indonesia	8.69	China	13.10	China	11.07
	Vietnam	8.64	India	9.24	Thailand	11.07
	China	7.17	Indonesia	8.97	Ecuador	10.66
	Denmark	4.02	Ecuador	6.65	Indonesia	8.12
	Mexico	3.65	Denmark	4.80	Argentina	3.70
	Netherlands	3.35	Netherlands	4.05	Denmark	3.30
	Bangladesh	3.22	Bangladesh	3.90	Netherlands	2.22
	Ecuador	3.20	Belgium	3.44	Canada	2.11
Processed Chicken	2000-2005	%	2006-2011	%	2012-2016	%
	China	21.62	Thailand	27.14	Thailand	29.27
	Thailand	19.42	China	15.12	China	15.77
	Netherlands	13.25	Netherlands	9.99	Germany	9.63
	United States	7.08	Germany	9.71	Netherlands	6.79
	France	6.11	Brazil	9.10	Brazil	6.61
	Germany	6.84	United States	4.24	United States	4.32
	Belgium	4.52	France	3.68	Denmark	3.36
	Brazil	4.09	Belgium	3.54	France	3.29
	UK	3.43	UK	3.40	Belgium	3.00
	Ireland	2.84	Denmark	2.79	Poland	2.50
Canned Tuna	2000-2005	%	2006-2011	%	2012-2016	%
	Thailand	43.07	Thailand	43.99	Thailand	39.75
	Spain	12.85	Spain	11.06	Ecuador	14.81
	Ecuador	11.67	Ecuador	9.91	Spain	9.53
	Mauritius	5.76	Mauritius	5.23	China	6.23
	Indonesia	5.55	Philippines	4.92	Indonesia	5.54
	Philippines	4.74	Indonesia	4.62	Philippines	5.49
	Italy	4.17	Italy	3.02	Mauritius	4.90
	France	3.80	China	2.87	Italy	2.74
	Germany	3.48	Netherlands	2.70	Netherlands	2.57
	El Salvador	2.85	Germany	1.95	El Salvador	1.56
Canned Pineapple	2000-2005	%	2006-2011	%	2012-2016	%
	Thailand	42.01	Thailand	49.18	Thailand	46.26
	Philippines	14.58	Philippines	13.60	Philippines	21.48
	Indonesia	12.21	Indonesia	12.08	Indonesia	13.56
	Kenya	7.24	Kenya	5.28	Kenya	5.17
	Germany	4.22	China	4.41	Netherlands	3.53
	Netherlands	3.87	Netherlands	4.15	Germany	2.21
	China	3.76	Germany	3.72	China	1.78
	South Africa	2.24	Belgium	1.06	Singapore	0.80
	Belgium	2.08	Malaysia	1.05	Spain	0.70
	Singapore	2.08	Singapore	0.93	Malaysia	0.54

Source: Author's calculations using the Global Trade Atlas Database (2017) and the UN Comtrade Database

Against this backdrop, the upgrading of Thai processed food is important to enure a well position in global export market. As discussed above, it is not easy to decide which upgrading types are suitable for each value chain due to the many requirements and product standards, including governance forms

in each value chain. Moreover, each type of upgrading needs appropriate support (Jespersen et al., 2014; OECD et al., 2014). Therefore, some important questions need to be answered. These are:

1. Which types of governance occur in the value chain of processed food?
2. Which type of upgrading is suitable for exporters?
3. What are the key factors that support upgrading?

Answers to the questions can assist policymakers to create appropriate policies to develop the processed food sector (Jespersen et al., 2014; Kowalski et al., 2015). In particular, Thailand, which was a relatively early entrant to the processed food exporting trade, has become a major exporter of these products over the past three decades. However, Thailand still faces many challenges related to global product standards and requirements. Understanding how Thailand's processed food value chain operates and how to upgrade it is important both to maintain the country's position in the GVC and the export competitiveness of its industry. This study analyses Thailand's process food exports (henceforth TPFEs) within the GVCs, namely the export structure, export competitiveness, and the implications of GVCs for Thailand's processed food sector (henceforth TPFS). In particular, the study is interested in how economic and social upgrading affects TPFEs and the determinants that influence the economic and social upgrading.

1.3 Research Objectives

1. To explore Thailand's processed food export structure, the governance of Thailand's processed food value chain, and Thailand's export competitiveness in processed food production.
2. To examine the impact of economic and social upgrading on the Thai processed food export sector.
3. To identify the key determinants that influence the economic and social upgrading of Thailand's processed food export sector.
4. To suggest policy recommendations for the development of Thailand's processed food export sector.

1.4 Scope of the Study

The study period covers 1998-2016. An increased importance of the GVCs approach to analyse the global trade in processed food is found during this period. In addition, the study period covers the adoption of food safety standards, such SPS, in global trade. These have had a significant impact on processed food exports around the world. The last reason is data availability. For example, most Thai processed food export data can be accessed from 1998 onwards via many important databases of global trade, such as UN Comtrade and Global Trade Atlas database. Descriptive analysis is used to answer the objective 1. The gravity model is used to estimate the impact of economic and social upgrading on TPFEs. The ordinary least square is used to identify the key determinants influencing the

economic and social upgrading of TPFS. Secondary data obtained from various sources are used in the study.

1.5 Contributions of the Research

This study contributes to the development of TPFS. The findings provide a more complete picture of the presence of governance in the value chain of TPFS, and Thailand's export competitiveness in processed food exports. The findings reveal the impact of economic and social upgrading on TPFEs and indicate key factors that support economic and social upgrading of TPFS. These findings are important for both private (producers and exporters) and government to develop TPFS.

For the private sector, the results can assist private firms to focus on the upgrading type(s) that has(ve) the greatest impact on processed food exports. It is not an easy task to decide which upgrading types are suitable for each value chain. To attain each type of upgrading, private firms need to invest their resources. As a result, the research finding is beneficial in creating some strategies to support upgrading.

The result is also signifincat for the government sector. The results can assist policymakers to create suitable policies to support upgrading of TPFS. This is because each upgrading type requires different support policies. In particular, policies should focus on the development of productive capacity (for R&D and HRD), infrastructure and service, the business environment, trade policies, and collaboration between private firms in the Thai processed food industry and the government. Thus, the findings contribute to the development of appropriate policies to support each upgrading type in Thailand's processed food industry. More importantly, the policies can assist private firms in the industry to achieve competitive advantages in the global trade in processed food.

1.6 Organisation of the Study

The study is organised as follows. Chapter One provides an introduction, research statement, research objectives, the scope of the study, and the contribution of the research. Chapter Two reviews the literature on GVCs. It defines the concept and provides an overview of the debates on GVCs. It identifies the GVCs components, GVCs role in country development, and the implications of the GVCs for the agri-food sector. Chapter Three provides a brief summary of TPFEs. It includes an overview of the export structure of TPFS, the governance characteristics of Thailand's processed food value chain and an analysis of Thailand's export competitiveness of the processed food industry. Chapter Four presents the methodology and empirical models. Chapter Five discusses the empirical results. Chapter Six presents the conclusions, implications, limitations of the study and possible future research.

Chapter 2

Global Value Chains

This chapter provides an overview of the literature related to the GVCs approach. It is divided into five sections. Section 2.1 explains the concept and the debates around the GVCs approach. Section 2.2 illustrates the components of GVCs, focusing on governance and upgrading. Sections 2.3 and 2.4 describe the role of GVCs in country development and the implications for the agri-food sector, respectively. Section 2.5 summarises the chapter.

2.1 Global Value Chains: the Concept and the Debate

The world trade system has evolved over the three past decades. Before the 1980s, the IS strategy was the main global trade policy (Kohpaiboon, 2006). The IS strategy is defined as the adoption of an exchange rate for the country's exports (ERx) which is less than that for imports (ERm) (Bhagwati, 1988). However, this strategy collapsed in the mid-1980s because of major problems related to world trade, such as the oil crisis in 1973 and trade negotiations (e.g., the Plaza Accord[5] in 1985). These problems caused economic problems in many countries. For instance, Japan lost its export competitiveness because of increased local wages and the appreciation of the Japanese yen; developing countries in Latin America underwent a debt crisis (Gereffi, 2014a; Kohpaiboon, 2006; Phongpaichit & Baker, 2002). Noticeable changes in the global trade system emerged in the mid-1980s when the EP strategy became a core international trade policy in both developed and developing countries (Athukorala, 1998; Kohpaiboon, 2006). The EP strategy is the adoption of ERx, which is greater than the ERm. If the ERx equals ERm, it is a neutral strategy (Bhagwati, 1988).

Since the EP strategy became the key trade policy of most countries, there has been an increase in offshore production. Because of technological development related production, such as transport and communication, the production fragmentation phenomenon was supported (The Office of Industrial Economics, 2015). This practice increases a country's competitiveness in the global market. Most developed nations, such as the U.S., Japan, and those in the EU, seek new production bases where there is excess labour available. Many nations in South East Asia, Latin America and Africa were selected as production bases because of their comparative advantage in the workforce through relatively low wages[6] (Kohpaiboon, 2006; Phongpaichit & Baker, 2002). With the emergence of

[5] One of the key effects of the Plaza Accord was the appreciation of some countries currency, e.g., the Japanese yen. As a result, Japan needed to seek new export bases to reduce its production costs and maintain its export competitiveness (Kohpaiboon, 2006).

[6] Most production bases are now located in developing countries, such as Thailand, Chile, Malaysia and Indonesia (Athukorala, 1998; Kohpaiboon, 2006).

offshore production, production becomes scattered. Most products are separated into sub-parts, that are made in different parts of the world. This is called production sharing or a production network (Cole & Yeung, 2015; Gereffi & Lee, 2012). This strategy is used to accomplish competitive production costs and gain higher profits from global trade (The Office of Industrial Economics, 2015).[7] Previous research has provided various names to describe this phenomenon in global trade: Global Commodity Chains (GCCs), Global Value Chains (GVCs), Global Supply Chains (GSCs), Global Production Networks (GPNs), Disintegration of Production, Unbundling of Production and Trade in Tasks (Baldwin, 2006; Feenstra, 1998; Gereffi, 1999; Gereffi et al., 2005; Grossman & Rossi-Hansberg, 2006). However, the Office of Industrial Economics (2015) notes that the meaning of these names is similar.

The GVCs approach has recently become popular as a key approach for analysing the expansion and geographical fragmentation of modern trade (Balié et al., 2018; Gereffi & Fernandez-Stark, 2011; Pietrobelli & Saliola, 2008; Shepherd, 2013). The GVCs approach can be traced back to the 1990s when Gereffi (1994, 1999) used the term "GCCs" to explain global trade. The GVCs approach highlights the delivery of goods or services from producers to final consumers via various phases of production, such as marketing and design, sourcing raw materials and production, and product (goods and services) distribution. This results in an increase in connections between all stakeholders (both domestic and overseas) in the value chain. This contributed to reshaping the global trade system (Gereffi et al., 2001; Singh, 2013).

GVCs can be separated into two: producer-driven and buyer-driven chains (Gereffi, 1999; Gereffi & Memedovic, 2003; Wijk et al., 2008). The producer-driven chain's characteristic is that it is in capital- and technology-intensive industries such as heavy machinery, automobiles, aircraft, computers, and pharmaceuticals. Normally, production in these industries is fragmented between various countries; parts and components are made in many different countries (Kohpaiboon, 2006). For example, in the automobile industry, large multinational companies, such as Toyota and Honda select developing countries (e.g., Thailand, Malaysia, Indonesia) as key production bases; they produce vehicle components. For instance, Malaysia produces part A, Indonesia produces part B, and those countries then transfer their parts to Thailand where the car is assembled (Kohpaiboon, 2011). Leading firms, which are usually multinational manufacturers, act as coordinators of the production network. Leading firms determine and control all the production processes, upstream to downstream[8] (Gereffi, 1994; Gereffi & Memedovic, 2003; Palpacuer et al., 2005). In contrast, the buyer-driven chain is

[7] Leading firms have recently changed their focus to core competency. Other activities are distributed to other firms, namely affiliates and outsourcing suppliers (both on-shore and off-shore). These activities rely on collaboration between stakeholders within the GVCs. Companies focus on global optimisation rather than local optimisation (The Office of Industrial Economics, 2015).

[8] Leading firms select developing countries that they use as their production bases to produce components. They control all of the production processes in the production network. Thus, the power within the chain is vertical, from leading firm headquarters to the producers (Gereffi & Memedovic, 2003; Kohpaiboon, 2006).

characteristically a labour-intensive industry and includes products like processed food, garments, footwear and toys. Generally, large retailers, marketers and branded manufacturers, such as Dole, Nike, Adidas, and Wal-Mart determine the network's production processes (Gereffi & Fernandez-Stark, 2011; Pananond, 2013; Padilla-Pérez & Hernández, 2010). To produce products that meet world consumer demands, these companies determine the requirements or set product standards for their suppliers. In the buyer-driven chain, suppliers for multinational companies are generally located in developing countries (Gereffi & Memedovic, 2003; Kohpaiboon, 2006). Companies that act as leading firms in the chain do not necessarily build their own factories in offshore countries; such a practice is called Manufacturers without Factories or Fab-less. For instance, focusing on the processed food industry, leading firms control their suppliers via product standards, i.e., food safety and quality standards (Gereffi & Memedovic, 2003; Jongwanich & Magtibay-Ramos, 2009; The Office of Industrial Economics, 2015).

Empirical research illustrates the key components of the GVCs approach. Through the lens of the GVCs approach, there are two core components: governance and upgrading that play a core role as the centrepiece of the approach (Altenberg, 2006; Gereffi et al., 2005; Humphrey & Schmitz, 2002). The governance component is defined as the non-market coordination of economic activities. It centres on the functions of leading firms and the organisation of multinational companies. It focuses on how to control supplier production processes and assigns functions for each stage in the production chain. As a result, the governance component can be defined as a top-down strategy (Gereffi et al., 2005; Mancini, 2013). On the other hand, upgrading normally relates to suppliers. The key advantage of upgrading is to maintain and improve a country's/supplier's position in the GVC to gain more benefits from the trade network. Some studies apply Stan Shih's smiling curve[9], to illustrate the benefits of upgrading (Elms & Low, 2013; Pananond, 2012; The Office of Industrial Economics, 2015). Figure 2-1 presents Stan Shih's smiling curve. If countries can move their function from assembly actors to distributors or brand designers, they achieve higher benefits from participation in the GVC (see Figure 2-1). These practices are called upgrading.

To sum up, the global trade system has changed during the last few decades (see Figure 2-2). Initially (before the mid-1980s), countries applied the IS strategy to their economy. However, this strategy became less popular because of the world economic recession and important trade negotiations (Kohpaiboon, 2006; Phongpaichit & Baker, 2002). This led to increased importance of the EP strategy (post the mid-1980s). Previous research has shed light on the GVCs approach as a new framework to explain modern trade. The term GVC refers to the delivery of goods or service from producers to final consumers via various phases of production within the world production chain. This process results in

[9] Stan Shih was founder of ACER Inc., a Taiwanese multinational hardware and electronics corporation (Elms & Low, 2013; Pananond, 2012; The Office of Industrial Economics, 2015).

an increase of connections between stakeholders within the production chain, both domestically and overseas. It emphasises value creation/capture across the full range of possible chain activities and end products (goods and services) (Gereffi, 1999; Singh, 2013). There are two core components to the GVCs approach. Governance and upgrading both play important roles in the GVCs approach. The governance component is that leading firms control suppliers within the chain. Upgrading refers to the suppliers and the transformation of their production processes to maintain and improve their position in the GVCs (Gereffi et al., 2005; Humphrey & Schmitz, 2000).

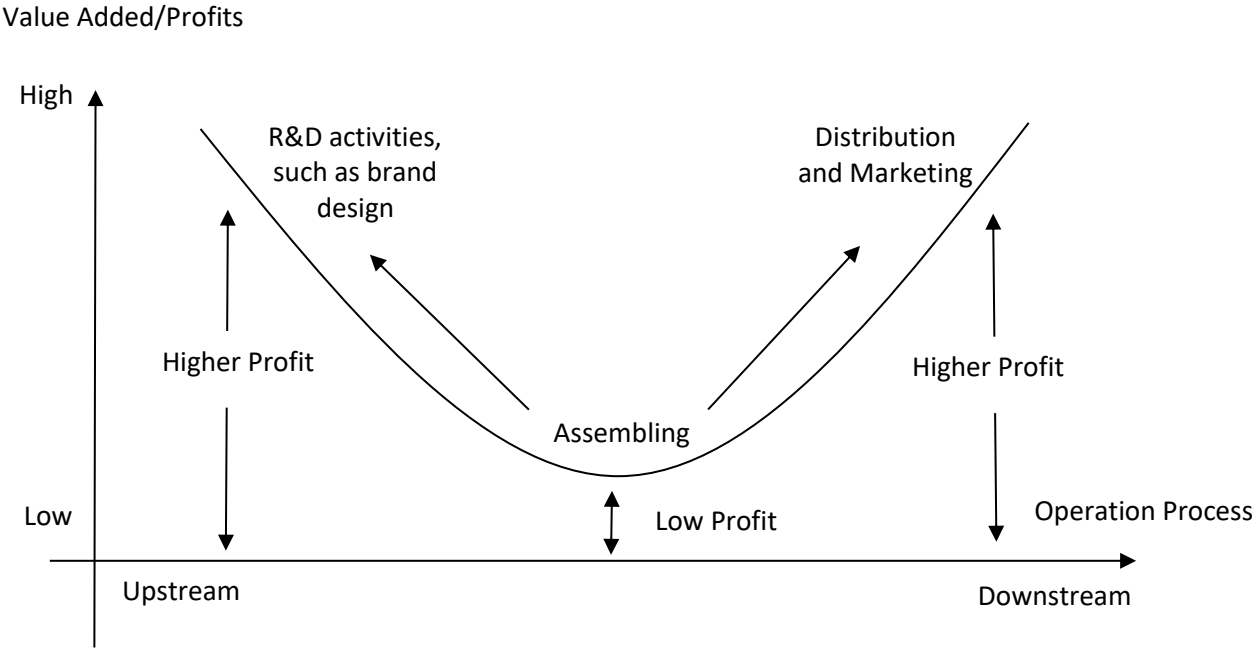


Figure 2-1 Stan Shih's Smiling Curve

Source: Adapted from Elms and Low (2013), Pananond (2012) and the Office of Industrial Economics (2015)

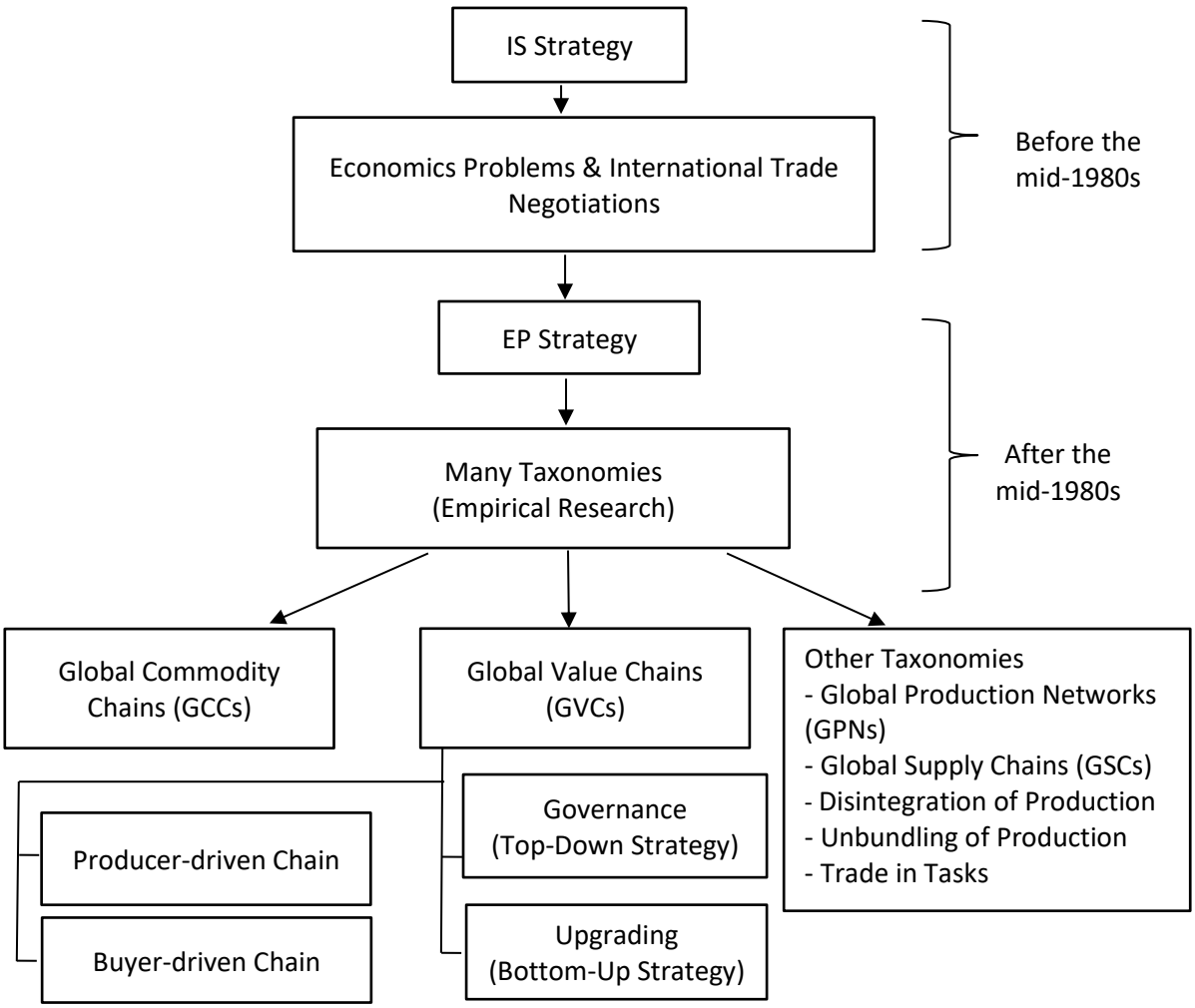


Figure 2-2 A Summary of the Important Historical Changes in the Word Trade System

Source: Developed by the Author

2.2 Global Value Chain Components: Governance and Upgrading

Many empirical studies have analysed the GVC approach. In particular, many studies focus on GVCs' components (Gereffi et al., 2005; Humphrey & Schmitz, 2002; Singh, 2013). Most scholars acknowledge that, as already stated, the component aspect of GVCs consists of two core activities: governance and upgrading.

2.2.1 Governance

Governance is a key instrument in GVC analysis. Governance relates to non-market relationships within production chains. It refers to the leading firm's competence in determining the production activities of other firms, the suppliers, in the chain. For example, country A (a leading firm) controls the production activities i.e., production and distribution plans, of product X produced in country B, (Gereffi, 2001; Singh; 2013). This is because several requirements of global demand emerge, such as

concerns about product quality and safety. As a result, leading firms are necessary to control the production processes in the value chain to meet those requirements.

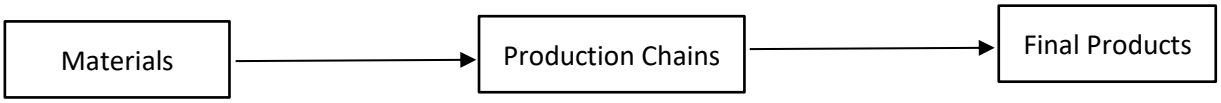
Previous studies have tried to present governance types from different academic perspectives. Governance types can be traced back to the 1990s. This was when the GVC approach became a key instrument to analyse the new global trade. Governance types examine the role of leading firms in GVCs. Leading firms are the firms that have the most power in any given production chain. Examining producer- and buyer-driven chains sheds light on their importance as key governance mechanisms (Gereffi, 1999; Ponte & Sturgeon, 2014; Tallontire et al., 2011). Focusing on producer-driven chains, multinational manufacturers play a core role as the key driver. Transnational companies establish their own factories in offshore countries, especially in developing countries, to gain a cost advantage from lower wages. Leading firms (multinational manufacturers) act as production coordinators, controlling production processes to achieve their requirements. This governance characteristic is found in the production chains that are capital-and technology-intensive: automobiles, aircraft, computers and pharmaceuticals industries. It can also been seen in industries with continuously changing technology (Gereffi, 1994; Gereffi & Memedovic, 2003; Palpacuer et al., 2005). The buyer-driven chain, in contrast, covers large retailers, marketers and branded manufacturers, such as Dole, Nike, Adidas, and Wal-Mart. These actors can control production chains without having their own factories; they are called "Manufacturers without factories". Those companies select developing countries and insert them into a given production chain as suppliers. The company establishes the requirements or product standards to control their suppliers. This type of governance (buyer-driven chain) is found in the production chains of labour-intensive industries, e.g., processed food, footwear and apparel (Gereffi & Fernandez-Stark, 2011; Padilla-Pérez & Hernández, 2010; Pananond, 2013). This is because most technologies employed within these industries are usually characterised as mature production technologies. Thus, the leading firms are not usually concerned about the outflow of their technology and can act as a multinational trading company. They can focus solely on the core competencies of designing, marketing and distributing. In particular, when those activities occur in overseas countries (off-shore production), distribution of those activities to indigenous firms seems appropriate. This is because the industries are characterised as labour-intensive; they need collaboration between the labour force and other stakeholders. Local firms that lack language constraints tend to deal with those activities better than leading firms that have that constraint with native people (The Office of Industrial Economics, 2015).

There have been ongoing debates about governance types in GVCs over the past few decades. Many empirical studies explain types of governance via new academic perspectives. Gereffi et al. (2005) and Humphrey and Schmitz (2002) focus on the activities that occur in value chains (making versus buying) and how they differ in governance types. To determine governance types, Humphrey and Schmitz

(2002) raise three questions: “What is to be produced?”, “How is it to be produced?” and “What is physical product flow?” in their framework to determine their governance types. According to Humphrey and Schmitz (2002), there are four types of governance: arm’s length market relations, networks, quasi-hierarchical, and hierarchical. Focusing on the two extreme cases, arm’s length market relations and hierarchical, the former refers to buyers and suppliers that do not have a close relationship since the products are standard or easy to produce. Any buyer requirement for a given product from buyers, can be met by suppliers without any special transaction. The latter is defined as the process where leading firms control all of the production processes in the chain. In other words, leading firms have direct control over the ownership of any given supplier. Hierarchical governance is usually called vertical integration. Network governance refers to the relationship between buyers and suppliers; it is closer than arm’s length market relations since the buyers need suppliers to meet specific product standards. Sharing competencies and reciprocal dependence between buyers and suppliers are necessary to meet those demands. For instance, buyers need to specify certain production processes and product standards, and suppliers need to meet those particular standards. In the quasi-hierarchical type, leading firms control almost all of the suppliers’ production activities because there is doubt about the suppliers’ competency.

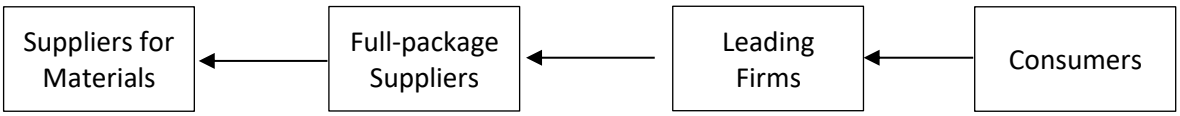
Gereffi et al. (2005) apply Humphrey and Schmitz’s (2002) concept to illustrate their governance types. According to Gereffi et al. (2005), there are three major determinants: the complexity of the transactions; the ability to codify transactions; and the capability of the suppliers. The complexity of the transactions refers to transferring complex information and knowledge between the actors in the chain, since information and knowledge are used as one key instrument in producing given products. The ability to codify transactions is related to the codification of sophisticated knowledge and information that can be transferred along the chain with minor costs. Finally, the capability of suppliers involves the suppliers’ performance in meeting all of the transaction requirements in the GVC. Based on these determinants, Figure 2-3 illustrates the five types of governance presented by Gereffi et al. (2005). A market relationship emerges when information is uncomplicated and easy to codify. Additionally, the supplier has a high ability to comply with the requirements and information proposed by the buyers and the cost of switching to a new partner is low for both buyers and suppliers. Product prices are the key instrument to connect buyers and suppliers in a market relationship. Secondly, modular governance occurs when suppliers with high capability can systematise highly complex information. Basically, consumers and leading firms share information and knowledge (which is easy to codify) about producing a given product with suppliers who have high capability and take full responsibility for producing fully-packaged products (full-packaged suppliers). Full-packaged suppliers coordinate with other suppliers, who provide materials for producing the given product (see Figure 2-3). Relational governance exists when there much complex information that is difficult to codify even

though suppliers have high capability. This often creates a mutual reliance between leading firms and particular suppliers. As the information and production knowledge is difficult to codify, leading firms take more time instructing and supporting their suppliers, who are called relational suppliers. Reputation or family and ethnic ties are key instruments in determining relational suppliers. Additionally, these suppliers cooperate with other suppliers to provide relevant support materials to produce specific products (see Figure 2-3). Captive governance is a situation where, although information and knowledge are complex, they are easily systematised. However, in this case, the supplier has low capability to comply with such knowledge and information. Small suppliers' production activities (captive suppliers) depend on the leading firm. Captive suppliers usually only produce a product, with the leading firm controlling almost all production activities. For example, these suppliers often produce a simple part of a specific product.

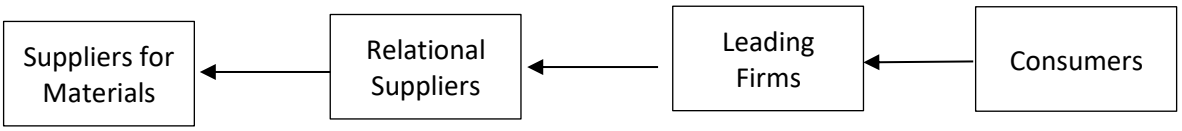


Markets: Low complexity of transactions, easy to codify transactions, high supplier capability

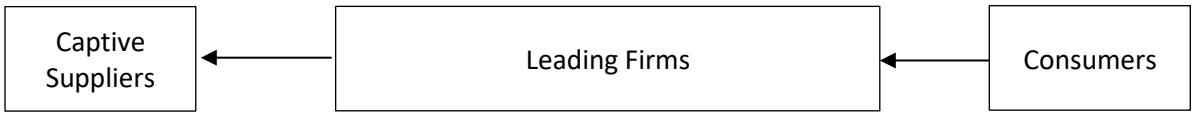
Modular: High complexity of transactions, easy to codify transactions, high supplier capability



Relational: High complexity of transactions, difficult to codify transactions, high supplier capability



Captive: High complexity of transactions, easy to codify transactions, low supplier capability



Hierarchy: High complexity of transactions, difficult to codify transactions, low supplier capability

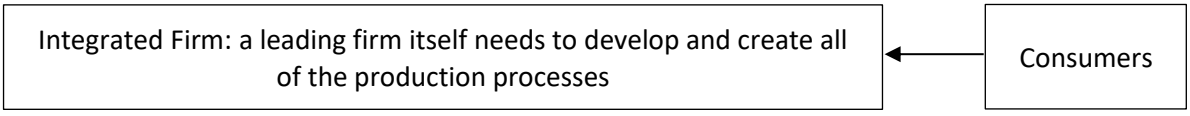


Figure 2-3 Governance Types

Source: Adapted from Gereffi (2011) and Gereffi et al. (2005)

Other relevant activities, such as product design, marketing strategy, logistics and technology upgrading are controlled by the leading firm (see Figure 2-3). Finally, hierarchical governance emerges when information and knowledge are highly complex and difficult to compile. In this instance, suppliers have poor capability. Under such conditions, all production processes are determined by the leading firm. In short, the leading firm develops and creates all production processes (Gereffi, 2011; Gereffi et al., 2005) (see Figure 2-3).

To sum up, governance is defined as the non-market coordination of economic activities within GVCs. Previous studies have examined the concept of governance and its various types. As shown in Figure 2-4, governance types are usually divided into two perspectives. First, some scholars consider the role of the leading firm that has the most power in any given production chain. This perspective separates types of governance into two subtypes: buyer- and producer-driven chains (Giuliani et al., 2005; Pietrobelli, 2008; Ponte & Sturgeon, 2014). This perspective focuses only on the role of the leading firm, but lacks explanations of transactions that occur among stakeholders in the GVC (see Figure 2-4). This is a significant knowledge gap. The second perspective examines transactions and linkage characteristics in value chain activities. This leads to a better understanding about how the value chain operates (see Figure 2-4). Two key empirical studies use this perspective. Humphrey and Schmitz (2002) present four types: markets relationship, networks, quasi-hierarchical and vertical integration. Gereffi et al. (2005) provide five types of governance in the GVCs: markets, modular, relational, captive and hierarchical. Interestingly, the types identified by Gereffi et al. (2005) and Humphrey and Schmitz (2002) are similar (see Figure 2-4). However, Gereffi et al.'s (2005) study, which apply Humphrey and Schmitz's (2002) work, provide a more complete picture of the relationships among stakeholders within GVCs, especially with respect to economic transactions along the value chain. As a result, Gereffi et al.'s (2005) governance concept is the subject of much academic research on the GVCs (Hamilton-Hart & Stringer, 2016; Kadarusman & Nadvi, 2013; Ponte & Sturgeon, 2014; Wijk et al., 2008).

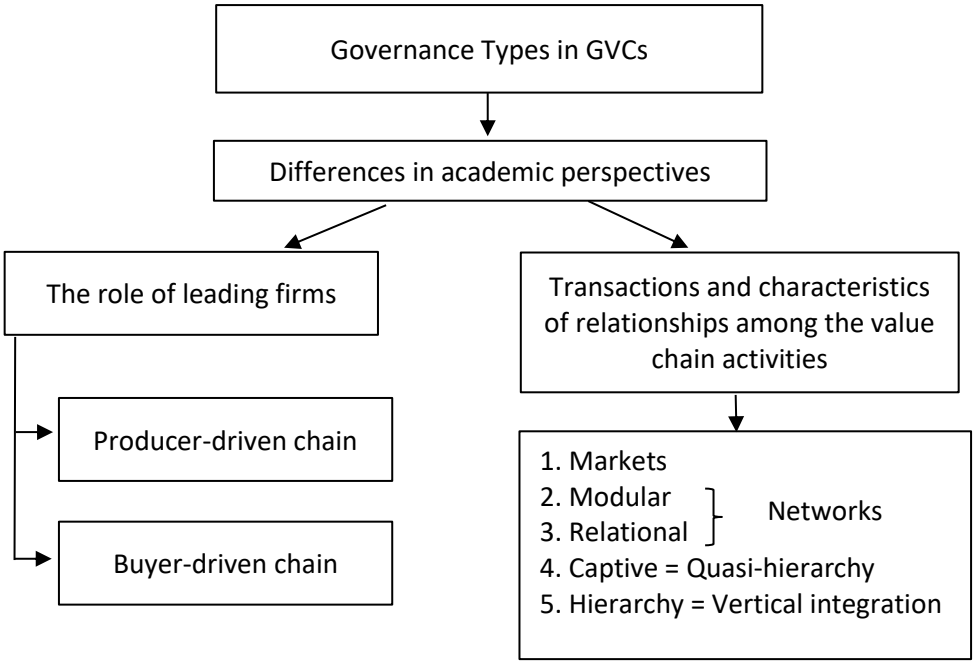


Figure 2-4 Governance Types in Different Academic Perspectives

Source: Developed by the author

2.2.2 Upgrading

Like governance, upgrading is a key component of the GVC analysis. Upgrading relates to economic activities that encourage firms or countries to shift from low-value activities, such as producing simple parts of products, to high-value activities, such as brand design or producing sophisticated products, or any activity that allows a firm/country to maintain its position in the GVC. This process is called going up the value ladder or climbing up the value chain (Barrientos et al., 2011; Pietrobelli, 2008; Ponte & Ewert, 2009).

Empirical studies try to describe the type of upgrading. The great pioneers who presented the types of upgrading are Humphrey and Schmitz (2002). The authors present four types of upgrading in GVCs: product upgrading, process upgrading, functional upgrading, and inter-sectoral upgrading. Product upgrading occurs when producers produce sophisticated products. In other words, this form of upgrading is when producers move from producing simple products to more complex ones. Process upgrading refers to transforming input factors, such as production resources (e.g., labour, capital, and technology) to outputs more efficiently through the reorganisation of relevant production activities (Giuliani et al., 2005; Hansen et al., 2016; Wijk et al., 2008). Functional upgrading emerges when producers achieve new functions in the GVC, such as in design, branding, and marketing or moving from assembly actors to distributors. For instance, suppliers can shift their business from Original Equipment Manufacturers (OEM) to Original Design Manufacturers (ODM), and further to Original Brand Manufacturers (OBM) (Haakonsson, 2009; Pananond, 2012). Finally, inter-sectoral upgrading

exists when firms move into new product activities. In other words, firms leverage some knowledge acquired from a current chain to insert their business into a new industry. For instance, firm A produces canned tuna for export. Firm A then employs its knowledge and experience to produce canned pineapple to export (Armando et al., 2016; Berman, 2011; Moazzem & Sehrin, 2016).

Humphrey and Schmitz's (2002) concept of upgrading is widely applied in GVC analysis. Some studies use different names for each type of upgrading (but have the same meaning), or apply Humphrey and Schmitz's (2002) study to present new types of upgrading (Alam & Natsuda, 2016; Armando et al., 2016; Ernst, 2008; Lu et al., 2015). For example, Humphrey and Schmitz's (2002) concept of "upgrading" is sometimes called industrial upgrading (consisting of products, processes, functional, and inter-sectoral upgrading) as found in Ernst (2008). Barrientos et al. (2011) and Fernandez-Stark et al. (2012) use "chain upgrading" to describe inter-sectoral upgrading. Armando et al. (2016) call inter-sectoral upgrading "inter-industry upgrading." Fernandez-Stark et al. (2012) identify a new type of upgrading they called "end market upgrading." This new type refers to the insertion of countries/firms into new higher-end market segments that may not relate to their current industry. For example, country A moves from the apparel industry to the automotive industry. In this situation, it is not necessary to employ knowledge and experience from the current industry to insert oneself into the new industry (Fernandez-Stark et al., 2012). Alam and Natsuda (2016) present a new type of upgrading called "volume-based upgrading." This form of upgrading refers to accomplishing economies of scale and diversifying into overseas markets. Lu et al. (2015) indicate that the combination of process, product and functional upgrading can be defined as "intra-industry upgrading," which is associated with increasing industrial competency in production and an improved position in GVCs.

Research has identified new types of upgrading. Trajectories in economic and social upgrading have increased in importance as they are seen as drivers of a country's development in GVCs (Barrientos et al., 2011; Bernhardt & Milberg, 2011b; Werner et al., 2014). Economic upgrading refers to ability of countries/firms to shift their position in GVCs by producing higher quality products, by increasing output efficiency, and by shifting to a new functional position in a GVC. As noted above, economic upgrading has the same meaning as "industrial upgrading". In contrast, social upgrading refers to processes of improvement in entitlements and workers' rights. It consists of measurable standards (wages, working hours and employment conditions) and non-measurable aspects (enabling rights, unbiasedness of employers and absence of harassment). Social upgrading has emerged recently as many countries in modern markets have been concerned about workforce issues, such as illegal labour, worker well-being, employment and wages (Dolan & Tewari, 2001; Lee & Gereffi, 2014). For instance, some developed countries are concerned about illegal employment issues (e.g., child labour) in Thailand's fishing industry. To avoid having its products banned, Thailand needs to solve these employment issues. As a result, social upgrading has become a key driver in upgrading Thailand's

position in GVCs (The Office of Industrial Economics, 2015; The Thai Union Group Public Company Limited, 2016).

Social upgrading can be caused by derived demand effects. In short, improvements in economic upgrading can influence social upgrading. However, Barrientos et al. (2011) and Bernhardt and Milberg (2011b) state that increased economic upgrading does not necessarily lead to social upgrading. For example, focussing on the trade environment of developing countries, these countries still use the labour-cost production advantage to enhance their export competitiveness in traded processed food. As a result, one can find problems related to the labour standards of the processed food industry in developing countries, such as human trafficking and labour exploitation. For example, Thailand, which has been a key producer and exporter of canned tuna and processed shrimp, has suffered from those labour problems (The Office of Industrial Economics, 2015).

There are some studies that use the concept of economic and social upgrading to create new types of upgrading. For example, Lim (2016) and Marchi et al. (2013) illustrate another type of upgrading, called environmental upgrading. This refers to improvement processes related to the environment. It includes waste management strategies, eco-designs and green activities that are kinder to the natural environment. Similarly, Barrientos et al. (2011) and Rainnie et al. (2013) provide an in-depth analysis of a form of social upgrading they call worker upgrading. These scholars divide worker upgrading into three subtypes: scale-worker upgrading, labour-intensive upgrading, and higher-skill upgrading. Scale-worker upgrading is described as workers employed under home-based production systems but are pleased with improved employment conditions. Labour-intensive upgrading is described as a situation where workers can move to more labour-intensive industries. Finally, higher-skill upgrading represents a situation where workers move towards better-paid employment related to progressive social upgrading.

In summary, upgrading plays a crucial role, especially for developing countries, in capturing additional benefits in GVCs. Upgrading refers to economic activities whereby firms or countries shift from low-value to relatively high-value activities, or at least maintain their current position in GVCs. Upgrading has been divided into various types (see Figure 2-5). For example, Humphrey and Schmitz (2002) provide four types of upgrading: process, product, functional, and inter-sectoral upgrading. These can be defined as a form of "industrial upgrading." Humphrey and Schmitz's (2002) concepts have been the subject of much research (Giuliani et al., 2005; Hansen et al., 2016; Wijk et al., 2008). Several new types of upgrading have been presented. Trajectories in economic and social upgrading shed light on the importance of novel types of upgrading (Barrientos et al., 2011; Bernhardt & Milberg, 2011a; Lee & Gereffi, 2014). Economic upgrading refers to a country/firm's ability to improve its position in GVCs

by producing more sophisticated products, by achieving efficiencies in production or by shifting to new functions (Barrientos et al., 2011; Bernhardt & Milberg, 2011a).

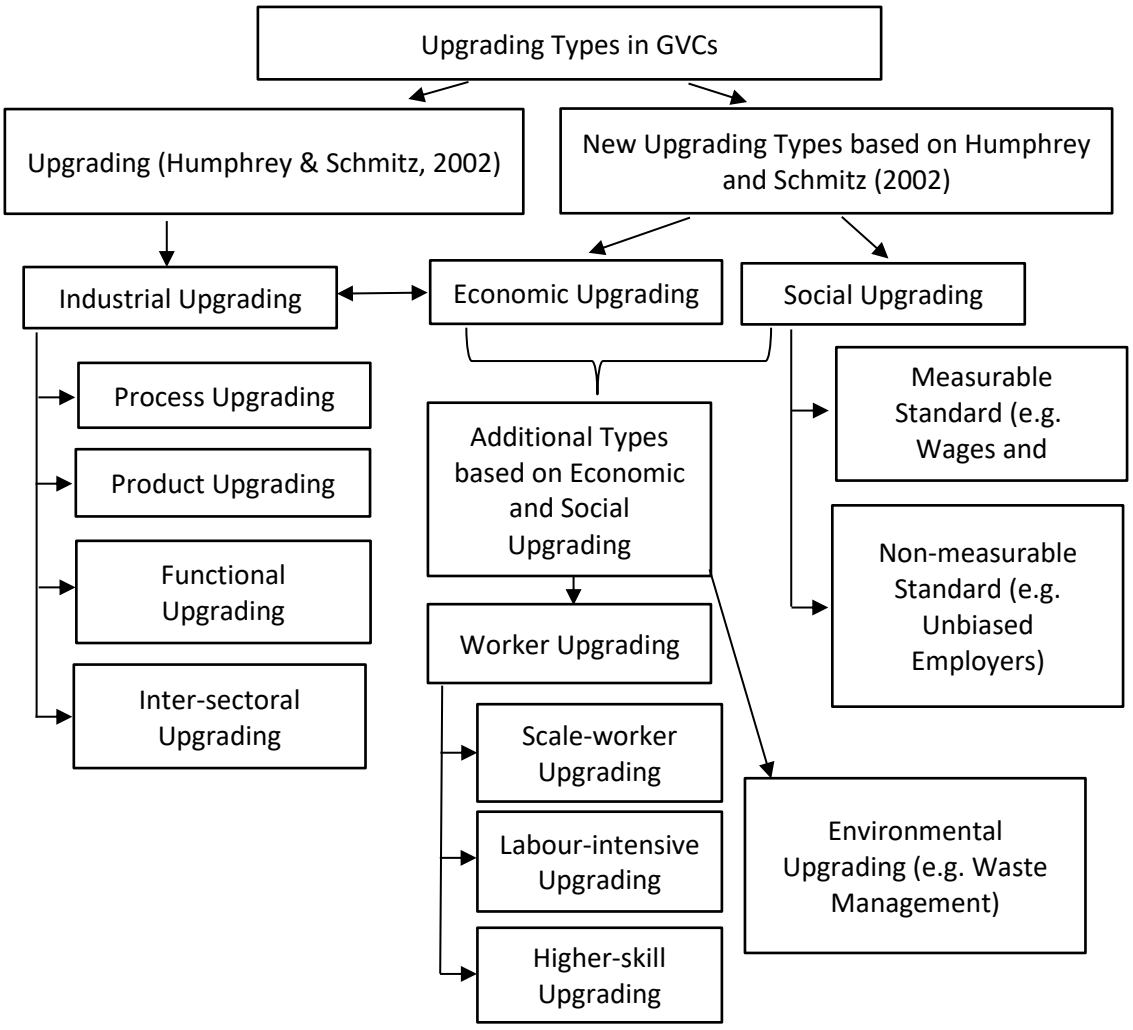


Figure 2-5 An Analysis of the Relationships among Upgrading Types

Source: Developed by the author

It is interesting to note that the definition of economic upgrading is similar to Humphrey and Schmitz's (2002) definition of industrial upgrading. Industrial upgrading and economic upgrading are essentially the same thing. Social upgrading, by contrast, is a more novel concept in GVC analysis. It occurs because many countries are concerned about workforce issues, like employment and wage issues (Dolan & Tewari, 2001). Social upgrading is defined improvement in worker entitlements and rights comprising measurable standards (e.g., wage increases and better employment conditions) and non-measurable aspects (enabling rights) (Bernhardt, 2013; Lee & Gereffi, 2014). There have been other attempts to develop new types of upgrading based on economic and social upgrading. However, these new types of upgrading (e.g., worker upgrading and environmental upgrading) are not widely acknowledged (Lim, 2016; Marchi et al., 2013; Rainnie et al., 2013).

2.3 Role of Global Value Chains in Country Development

GVCs have played a key role in driving the modern trade. When production processes are fragmented in many subparts, both developed and developing countries must create production networks to produce those products. Developed nations are generally positioned as leading firms that control production processes using different forms of governance. In contrast, developing countries, which act as suppliers or producers, produce products in line with leading firms' standards or requirements (Cole & Yeung, 2015; Gereffi & Fernandez-Stark, 2011; Greenville & Kawasaki, 2018; Kohpaiboon, 2011).

Developed countries gain some advantages from their participation in these chains. They can reduce their production costs by selecting developing countries with an abundance of labour to be their production bases for exports. For example, to reduce production costs, especially labour wages, Japan relies on developing countries in South East Asia (e.g., Thailand, Indonesia, and Malaysia) as production bases for its exports because of these countries' labour-intensive advantages. This enables Japan to stay competitive in the global market (Athukorala, 1998; Kohpaiboon, 2006; The Office of Industrial Economics, 2015).

GVCs are remarkably important for developing nations. When production is disaggregated into many sub-stages, it allows developing countries to participate in the chain. Previous research has acknowledged that participation in GVCs generates benefits for developing countries (Greenville & Kawasaki, 2018; Wang et al., 2018). Developing nations can achieve economic growth[10] and absorb new knowledge and technology that is in the GVCs. This can be used to improve their production processes or lead to upgrades in the relevant sectors, such as employment (Altenburg, 2006; Balié et al., 2018; Barrientos et al., 2011; Fernandez-Stark et al., 2012). For example, in the apparel industry, Bangladesh, which is a key producer in this chain, has increased its employment level. In addition, Bangladeshi's world market share and export value of the apparel industry have noticeably increased during its participation in GVCs (Moazzem & Sehrin, 2016). In the coffee industry, many countries in Central America, such as Guatemala and Honduras, are key producers. They can upgrade their production processes to become premium coffee producers by adopting technology and knowledge from the leading firms. As a result, their export values have increased remarkably. For example, Guatemala has increased its export value of premium coffee from 20% of total coffee export in the 1980s to about 80% in 2010 (Gereffi, 2015). Moreover, through their participation in GVCs, countries can improve their local knowledge. For instance, Uruguay, a leading producer of livestock, used techniques and knowledge from the leading firms in the industry to develop a local livestock

[10] OECD et al. (2014) indicate that developing countries with noticeable growth in GVC participation have seen increases in Gross Domestic Product (GDP) about 2% above the average. Gereffi (2014b) shows that GDP growth rates of emerging countries, such as China, India, Brazil and Mexico, that participate in GVCs are distinctly higher than the world average (3.4% versus 3%).

traceability system. This system has become a key instrument for monitoring the national cattle herd to protect it from diseases like foot-and-mouth disease (Gereffi, 2015).

Not all countries are equally involved in GVCs; this is particularly true of developing countries; some countries participate in many different areas of GVCs, such as becoming a host country for multinational companies or a supplier of specific products. Others play a more minor role (OECD et al., 2014). Moreover, some countries are banned from participating in GVCs since they cannot meet specific requirements relating to product quality, labour and environmental standards (Andersson, 2019; Cato & Santos, 1998; Kadarusman & Nadvi, 2013; Kindji & Faure, 2014; Unnevehr, 2000). For instance, in 1997, the EU banned aquaculture goods from Bangladesh because of deficiencies in the infrastructure and a lack of hygiene standards in the processing establishments. This led to increased public health risks (such as microbial contamination). Other countries also began to investigate these products. For example, all shipments of aquaculture goods from Bangladesh to the U.S. market were tested and allowed to enter only if they met the U.S. food safety standards (Cato & Santos, 1998; Unnevehr, 2000). Since introducing new hygiene standards (i.e., Hazard Analysis and Critical Control Points (HACCP)), Bangladesh has been able to recover much of its export trade in this area, which equates to approximately 35 million U.S. dollars per year (Kindji & Faure, 2014). Kenya met a similar problem. In 1996, it regularly exported fish products to the EU. However, in 1997, the EU raised concerns about Kenya's hygiene standards, which had a negative effect on the Kenyan fishing industry with fresh fish banned for six months (Henson et al., 2000; Jaffee & Henson, 2004). Guatemala was a key exporter of raspberries to the U.S. market in the late 1980s. Exports of this product reached 3 million U.S. dollars in 1996, with about 85 growers participating. However, the U.S. Centre for Disease Control and Prevention and Health Canada found 1,465 cases associated with plant disease, which affected food safety standards. As a result, the Guatemalan raspberry industry collapsed. In 2001, the export value of this product had dropped to 200,000 U.S. dollars. Guatemala lost its position in the US raspberry market; Mexico became the main supplier. Mexican raspberry exports grew from 2.9 to 8.9 million U.S. dollar during the period (Jaffee & Henson, 2004).

Most of the literature examines barriers to participation in GVCs (Gibbon, 2008; OECD et al., 2014; Trienekens, 2011). As product quality is a key concern, it is not surprising that there are product standard requirements. Some of these requirements are difficult to meet, such as stringent food safety standards and high product quality. To meet these requirements, developing countries that act as key producers in GVCs need to improve both production processes and other relevant factors, such as labour skills, infrastructure and R&D. However, it is occasionally difficult to develop all of them. As a result, they become barriers to participation in GVCs (Jaffee & Henson, 2004; Trienekens, 2011). Gibbon (2008) states that most entry barriers in GVCs relate to production costs (economy of scale and cost advantage) and product characteristics (level of product differentiation). If newcomers try to

insert themselves into a GVC, they face competition with producers who already have the knowledge and skills in these area. Trienekens (2011) provides evidence of different entry barriers. The author identifies four key barriers that affect participation in GVCs: market access restrictions, weak infrastructure, a lack of resources, and quality of institutions. OECD et al. (2014) separate barriers to participation in GVCs into three groups: investment climate, business environment and trade issues.

OECD et al. (2014) note that 'investment climate' refers to a country facing inadequate infrastructure, market entry costs, a lack of comparative advantage and an inability to attract FDI from overseas countries. Of these, OECD et al. (2014) indicate that inadequate infrastructure is the most important factor affecting GVC participation. For the business environment, OECD et al. (2014) show that limited access to finance and inadequate skills/labour act as barriers. The last group of entry barriers, trade issues, covers standards compliance, border procedures, trade restrictions and burdensome documentation. Of these, standards compliance is the most important. Kowalski et al. (2015) present a new barrier and argue that a country's location can be a barrier to participation in GVCs. If countries are located in remote areas, they may find it harder to attract international investment or participate in GVCs.

Participation and upgrading are necessary for country development. In particular, focusing on developing countries, they can capture higher benefits from a wide range of activities in a chain. For example, nations can improve their production processes by absorbing new techniques and knowledge available within the chain (Fernandez-Strake et al., 2012). However, not all countries are equally involved in GVCs or can insert themselves into a chain. In short, there is no simple way to participate in GVCs (Gereffi, 2014b). This is because there are many entry barriers and product requirements (such as hygiene, quality and environmental considerations). It is why most of the recent literature focuses on policies (Bamber et al., 2014; Kowalski et al., 2015; Shepherd & Wilson, 2009). There are three main perspectives on policies that support country development to participate and upgrade itself in GVCs.

The first perspective suggests that trade facilitation is essential to support countries to insert or upgrade in GVCs (Blyde & Iberti, 2014; Henson & Jaffee, 2008; Kellenberg, 2015; Shepherd & Wilson, 2009). Trade facilitation refers to a broad range of activities that reduce the cost of imports and exports. It is separated into two types: hard and soft infrastructure (see Figure 2-6). Hard infrastructure is physical infrastructure (e.g., roads, ports and airports) and the development of information and communications technology (ICT) (e.g., high-speed internet and telephone services). Soft infrastructure refers to border and transport efficiency (e.g., the number of days to export goods) and the business and regulatory environment (such as government transparency) (Mayer & Milberg, 2013; Portugal-Perez & Wilson, 2012).

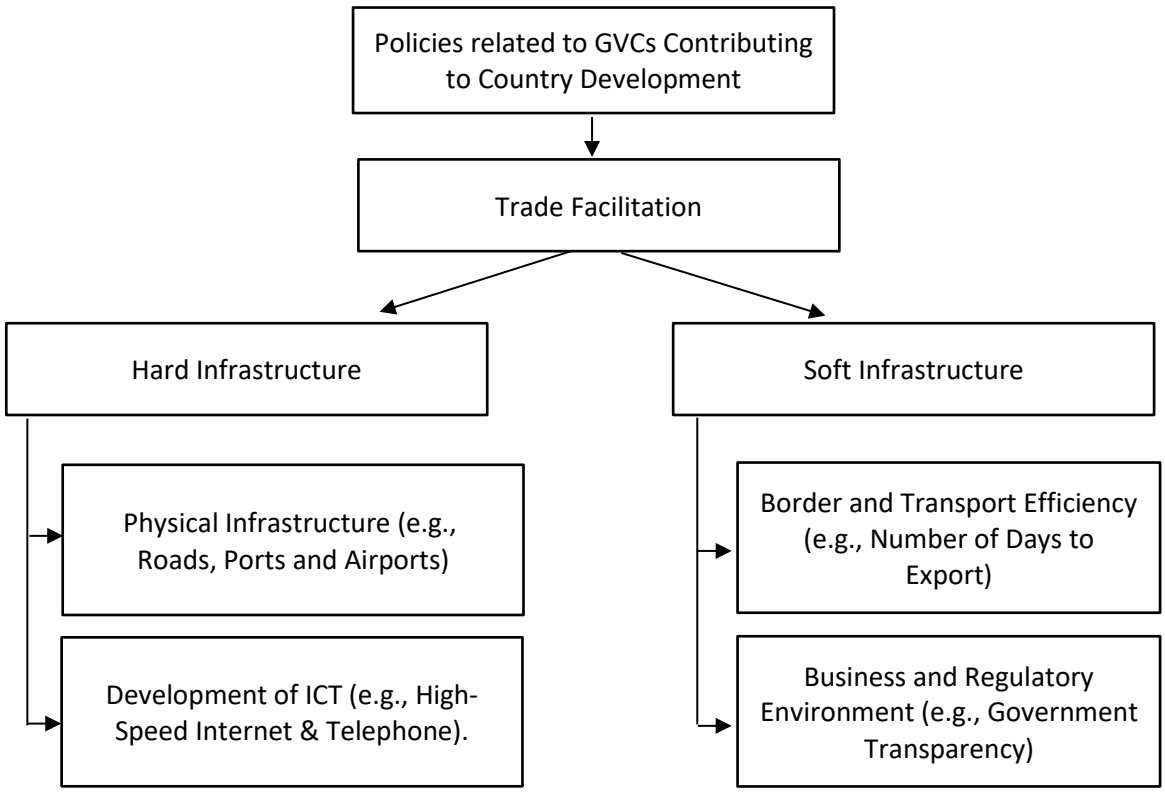


Figure 2-6 The First Perspective on Policies related to GVCs' Contribution to a Country's Development

Source: Adapted from Blyde and Iberti (2014), Henson and Jaffee (2008), Kellenberg (2015), Shepherd and Wilson (2009)

For the second perspective, there is some evidence that suggests that public policies affect the competitiveness or participation in GVCs (Bamber et al., 2014; Kowalski et al., 2015; Maisonneuve, 2016). These can be divided into five core determinants: productive capacity, infrastructure and services, business environment, trade and investment policy, and industry institutionalisation (henceforth the five determinants) (Bamber et al., 2014; Kowalski et al., 2015; Maisonneuve, 2016; OECD et al., 2014).

Determinants related to productive capacity focus mainly on human capital, standards and certification, and national systems of innovation. For human capital, much empirical research indicates that skilled training and educational development is significant for developing nations to participate and upgrade their position in GVCs. In particular, upgrading in the processed food value chain requires a number of workers with high skill levels (Bamber et al., 2014; OECD et al., 2014). Standards compliance is also associated with productive capacity development. This is because, when developing countries desire to participate or upgrade themselves, they need to meet global product standards. Accordingly, developing countries' governments need to determine standards regulations to ensure export product quality, e.g., SPS, GAP, and HACCP (Fromm, 2007). Innovation is essential to alleviate

technological gaps. Some research shows that it is also important for human development and to attract FDI. This leads to an increase in countries undertaking upgrading in GVCs (Bamber et al., 2014).

Determinants related to infrastructure and service, centre on transport, ICT, energy, water and necessary infrastructure. Previous research has acknowledged that good transport and infrastructure can stimulate export growth and a country's ability to upgrade itself in GVCs. This is because they can reduce moving product costs from producers to final destinations (AfDB et al., 2014; OECD et al., 2014). Some scholars state that each industry needs a different type of infrastructure. For instance, transport and water infrastructure are crucial for participation and upgrading in agri-food value chains (Bamber et al., 2014).

The business environment is another key determinant for participation and upgrading in GVCs. The business environment relates to macroeconomic stability and public governance, ease of opening a business, permits/licensing, and financial assessment (OECD et al., 2014). Focusing on macroeconomic stability and public governance, some indices represent these determinants, e.g., the exchange rate. For instance, if an exchange rate varies, it affects the cost (causing volatility) and leads to uncertainty in terms of input and product prices for exports. Absence of corruption and political stability are also crucial for a well-functioning business environment. This helps suppliers, investors and exporters reduce political risks that may affect their businesses (Kowalski et al., 2015). With regard to ease of opening a business and permits, Bamber et al. (2014) argue that fast and easy processes, as well as low cost are necessary to attract investment from multinational companies to emerging countries. This can lead to knowledge spillovers and, further, to upgrading in GVCs. Likewise, financial assessment is acknowledged as a key factor supporting developing countries' participation in GVCs. It enables these countries to upgrade their production processes to meet global standards (Berman, 2011; Global Harvest Initiative, 2013). OECD et al. (2014) indicate that limited access to finance is one of the most important factors hindering participation in GVCs.

Trade and investment policy is a key driver of upgrading in GVCs. It includes activities related to market access, trade openness, tariff and non-tariff measures, export-import procedures, border transition times and industry-specific policies, such as special economic zones (SEZs) or related programmes (Bamber et al., 2014; OECD et al., 2014). For instance, much research acknowledges that a degree of trade openness has positive impacts on trade flows and social upgrading (Mahutga, 2014; Tejani & Milberg, 2016). The complexity of export-import procedures and border transition times reduces reliability and the timeliness of product delivery. Some research suggests that SEZs encourage social upgrading, since an increase in SEZs leads to a shift in domestic employment (Milberg & Winkler, 2011).

Industry institutionalisation relates to industry maturity and coordination, and public-private coordination (OECD et al., 2014). High levels of collaboration among industry stakeholders (e.g., the

government, private and non-profit sectors) results in gainful participation in GVCs (Bamber et al., 2014). Cooperation between these parties ensures that infrastructure, education, investment and trade policies jointly contribute to countries' development goals. For instance, in the processed food sector, government and the private sector should establish laboratories to ensure product quality before exporting goods to comply with trading partners' product standards.

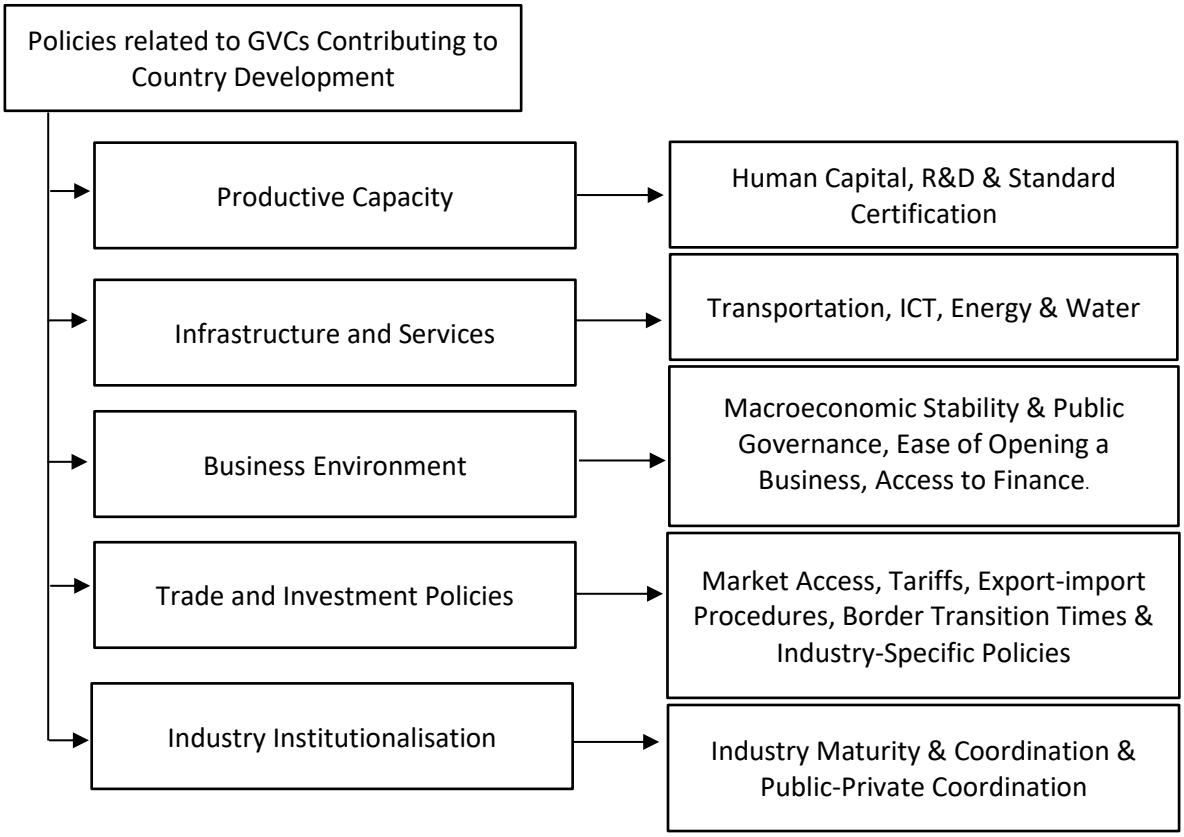


Figure 2-7 The Second Perspective on Policies related to GVCs' Contribution to a Country's Development

Source: Adapted from Bamber et al. (2014), Kowalski et al. (2015) and Maisonneuve (2016)

The last perspective separates policies into three categories: horizontal, selective (vertical) and GVC-oriented industrial policy. Horizontal policy centres on fundamental policies related to the whole national economy, such as education, health, infrastructure and R&D. Selective (vertical) policy, in contrast, focuses on specific industries or sectors (and is often called domestic industrial policy). GVC-oriented industrial policy relates to re-creating entire supply chains within a nation. In short, this type of policy is commonly used in the IS strategy (see Figure 2-8) (Elms & Low, 2013, Gereffi, 2014b; Gereffi, 2015).

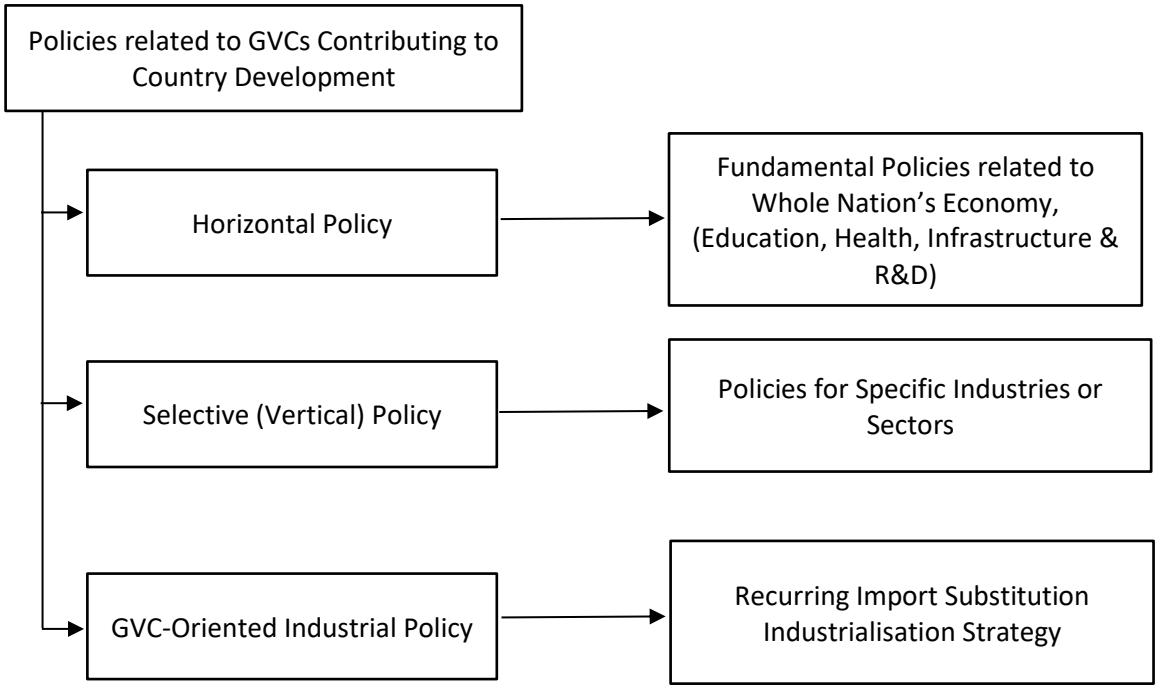


Figure 2-8 The Third Perspective on Policies related to GVCs' Contribution to a Country's Development

Source: Adapted from Elms and Low (2013), Gereffi (2014b) and Gereffi (2015)

Although previous research identifies several policies that support upgrading and participation in GVCs via different perspectives, some parts of those policies overlap (see Figure 2-9). With regard to the group in the second perspective, policies presented by this group seem to be able to cover other policies provided by other perspectives. The second perspective provides a greater range of policies than the other two groups. For example, the first perspective suggests that trade facilitation is important to a country's development or for inserting themselves into GVCs (Henson & Jaffee, 2008; Shepherd & Wilson, 2009). Indeed, trade facilitation is included in infrastructure and service and business environment (in the second perspective) (Bamber et al., 2014; Kowalski et al., 2015). Meanwhile, the third perspective indicates that policy associated with developing countries participation in GVCs can be divided into three sub-types: horizontal, selective, and GVC-oriented industrial policies (Elms & Low, 2013; Gereffi, 2014b). The definition of horizontal policy is like the definition of hard infrastructure (provided by the first perspective) and the definition of productive capacity and infrastructure and services (presented by the second perspective) (Gereffi, 2014b; Shepherd & Wilson, 2009). Selective policy still lacks specific details in relation to practical policy, for example, "Which policy's dimension should be focused on?". In other words, selective policy provides only a general idea; as a result, it is difficult to practice. GVC-oriented industrial policy seems to contradict the key export policy of the world market that employs the EP strategy as a key framework (Kohpaiboon, 2006).

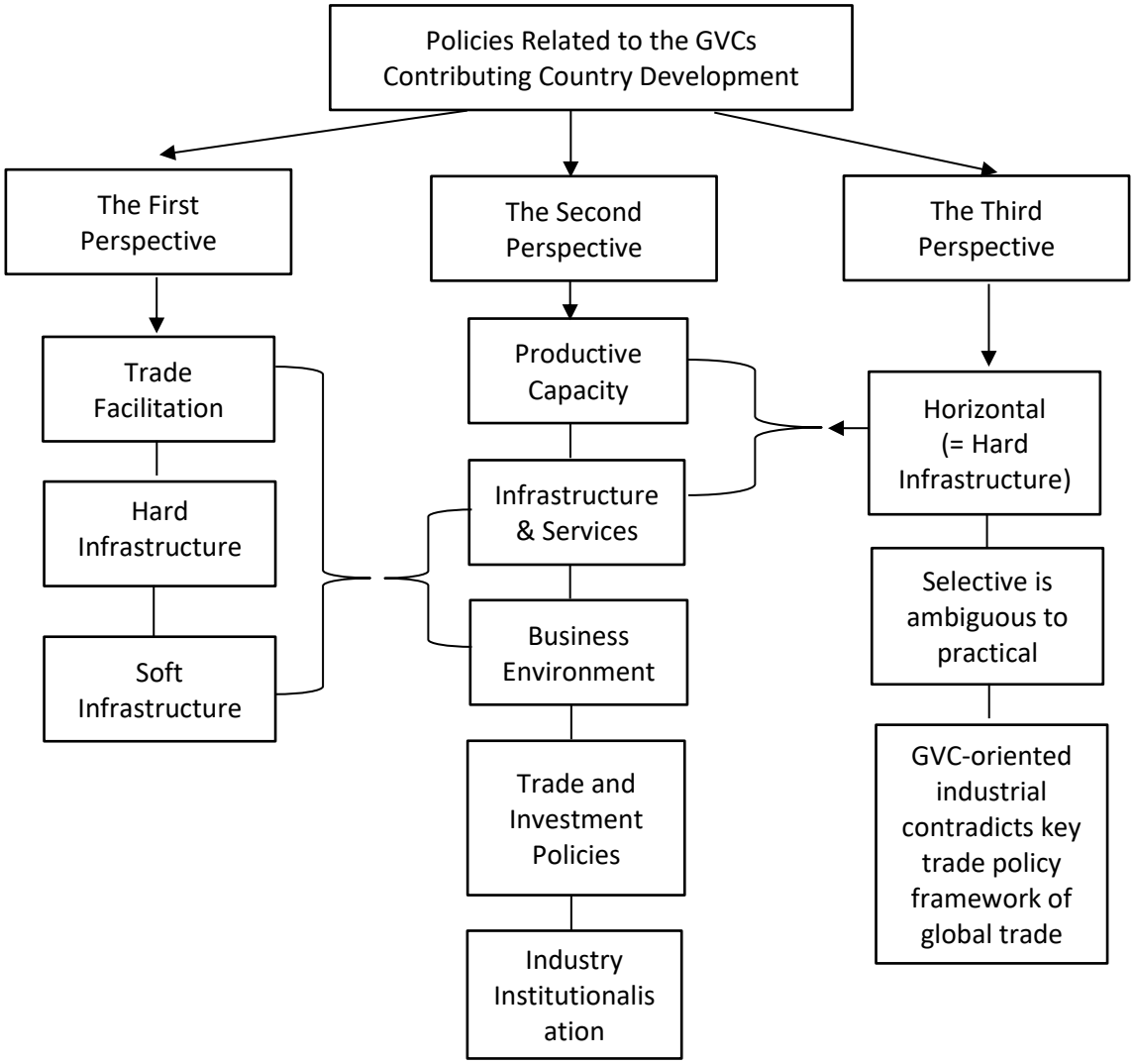


Figure 2-9 Summary of Policies related to the GVCs' Contribution to a Country's Development

Source: Developed by the author

2.4 Implications of GVCs in the Agri-food Sector: Debates and Evidence

Over the past three decades, the GVC approach has become a key instrument in analysing various production chains. It illustrates a range of activities that occur between stakeholders within the chains. The relationship between two core components: governance and upgrading, is a centrepiece of the GVCs analysis (Gereffi et al., 2005; Humphrey & Schmitz, 2002). The relationship between governance and upgrading is complex since it depends on the characteristics of each production chain. In the other words, there is no simple and exact way to create a specific pattern to illustrate all production chains in every country. As a result, understanding the operation of the value chain is crucial for a country's development. This is because it can help policymakers create a suitable roadmap for a country's development. Accordingly, countries can capture and maximise their benefits from participation in GVCs (Gereffi, 2001).

There are plenty of empirical studies which apply the GVC approach to analyse many production chains, particularly in the agri-food sector (Ponte & Ewert, 2009; Ponte et al., 2014; Tran et al., 2013). The agri-food sector, especially processed food, has increased in importance as a key engine driving the agrarian sector in the modern trade era (Athukorala et al., 2002; Jongwanich & Magtibay-Ramos, 2009; Wang et al., 2018). This is for key reasons such as changes in the internationalisation of food habits, improvements in food technology, refrigeration facilities, transport, and infrastructure (Athukorala et al., 2002). Agricultural sector GVCs are organised by leading firms and global buyers. They have specific requirements, particularly in relation to food safety and quality standards, and control their suppliers through the value chain. This is to accomplish high product quality, which is consumers' demand (Andersson, 2019; Greenville & Kawasaki, 2018; OECD, 2012; Ponte & Ewert, 2009; Tran et al., 2013). Suppliers must meet these standards to participate in agri-food chains. Although suppliers can absorb new technology and knowledge from the leading firms to upgrade their production processes, they also need to develop other areas, including infrastructure, transport, access to finance, and human resource management (Jaffee & Henson 2004; Ouma, 2010). This enables them to climb up the value chain to reach higher positions in the chain, which leads to greater benefits.

The GVC approach has been used to examine many different areas of the agri-food sector. For example, Ponte (2009) and Ponte and Ewert (2009) apply the GVC approach to analyse the wine value chain in South Africa. They indicate that producer–wholesalers, marketers and retailers play important roles (as leading firms) in this chain. The UK retailers, in particular, have high standards relating to quality for the South African wine industry. To maintain and move to higher positions in the wine's global value chain, the South African wine industry must upgrade certain areas of its production. For example, in product upgrading, the industry can improve the overall intrinsic quality of its wine. The industry can achieve higher unit prices and increase the proportion of exports for the total production of the wine industry. The industry can improve many production processes, such as managerial systems, as well as viticulture and winemaking practices. The South African wine industry uses many voluntary standards related to labour conditions and food safety to upgrade its production processes (process upgrading). Functional upgrading is reflected in producer-wholesalers in South Africa moving away from wine making to joint ventures with other agents and marketers in the wine industry in European countries (Ponte, 2009; Ponte & Ewert, 2009).

Vietnam's shrimp value chain is another example. Tran et al. (2013) show that Vietnam's shrimp value chain consists of four key functional stages: input, production, shrimp collection and processing, and exports (see Figure 2-10). The U.S., the EU and Japan are the primary importers of Vietnamese shrimp. They have food safety standards that must be met by Vietnamese shrimp producers. There are multiple types of governance in this industry. For instance, the relationship between wholesale agents, who act

as shrimp collectors, and farmers is captive governance. This is because the agents need to ensure that shrimp products meet specific processing and export requirements. Focusing on the relationship between processors and wholesale agents, there are various forms of governance, ranging from relational to captive governance. For upgrading, all actors in the Vietnam shrimp value chain are confronted with challenges related to food safety standards (e.g., SPS) proposed by the norther[11] markets. To meet these standards, actors in the chain needed to upgrade their production processes and obtain some guidelines, especially on how to comply with food safety standards. The Vietnamese government created regulations to control shrimp production processes to meet those standards. Some processors provide farmers with financial assistance to upgrade their production process (Tran et al., 2013).

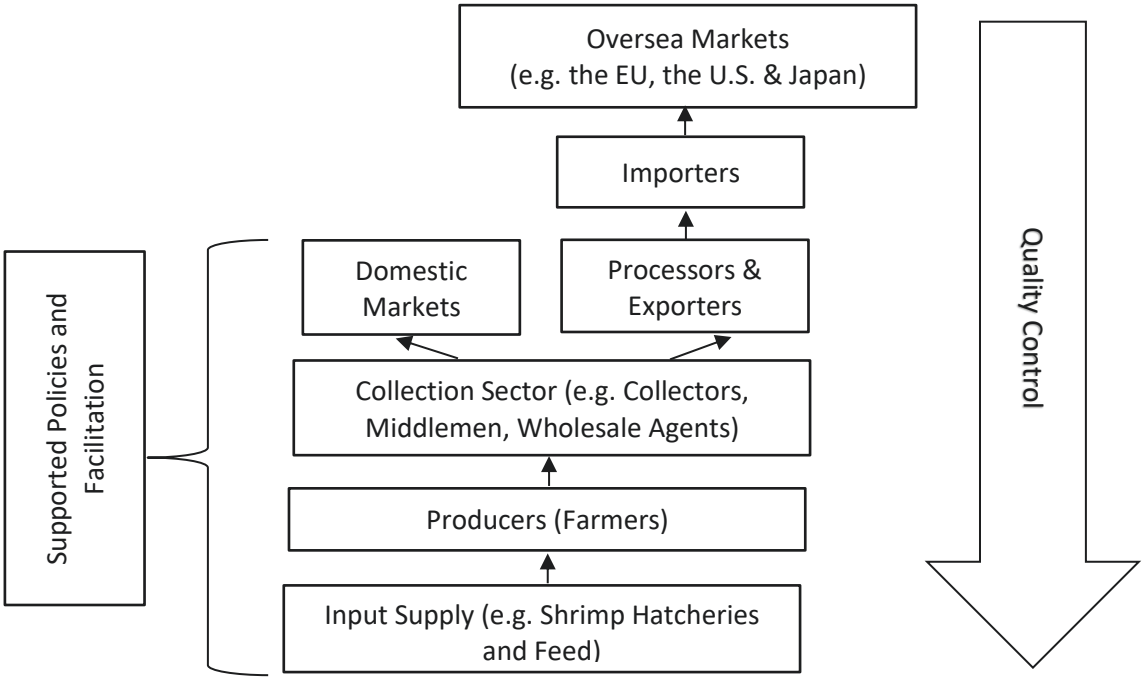


Figure 2-10 The Global Value Chain of Vietnamese Shrimp

Source: Adapted from Tran et al. (2013)

Jespersen et al. (2014) and Ponte et al. (2014) use Gereffi et al.'s (2005) governance types to illustrate relationships within agri-food GVCs. Jespersen et al. (2014) and Ponte et al. (2014) focus on specific agri-food value chains, the Chinese tilapia and Vietnamese pangasius value chains. Jespersen et al.'s (2014) and Ponte et al.'s (2014) findings suggest that the Chinese tilapia value chain is characterised by multi-governance (hierarchical, captive, and market) depending on the production activities of each stage. For example, the relationship among retailers, the processing sector and farmers (contract farming) are organised by captive governance. The relationship between the processing sector and

[11] The northern market refers to developed countries (rich countries). The southern market is, by contrast, developing countries (Bamber et al., 2014; Tran et al., 2013).

individual farms is governed by a hierarchy. Coordination between middlemen and the processing sector can be seen as a form of market governance (see Figure 2-11). Most types of upgrading occurring in the Chinese tilapia value chain Chinese tilapia are found in process and product upgrading, such as improved production processes (for example, applying food safety standards), training the workforce and producing more sophisticated products (e.g., frozen tilapia fillets) (Jespersen et al., 2014; Ponte et al., 2014).

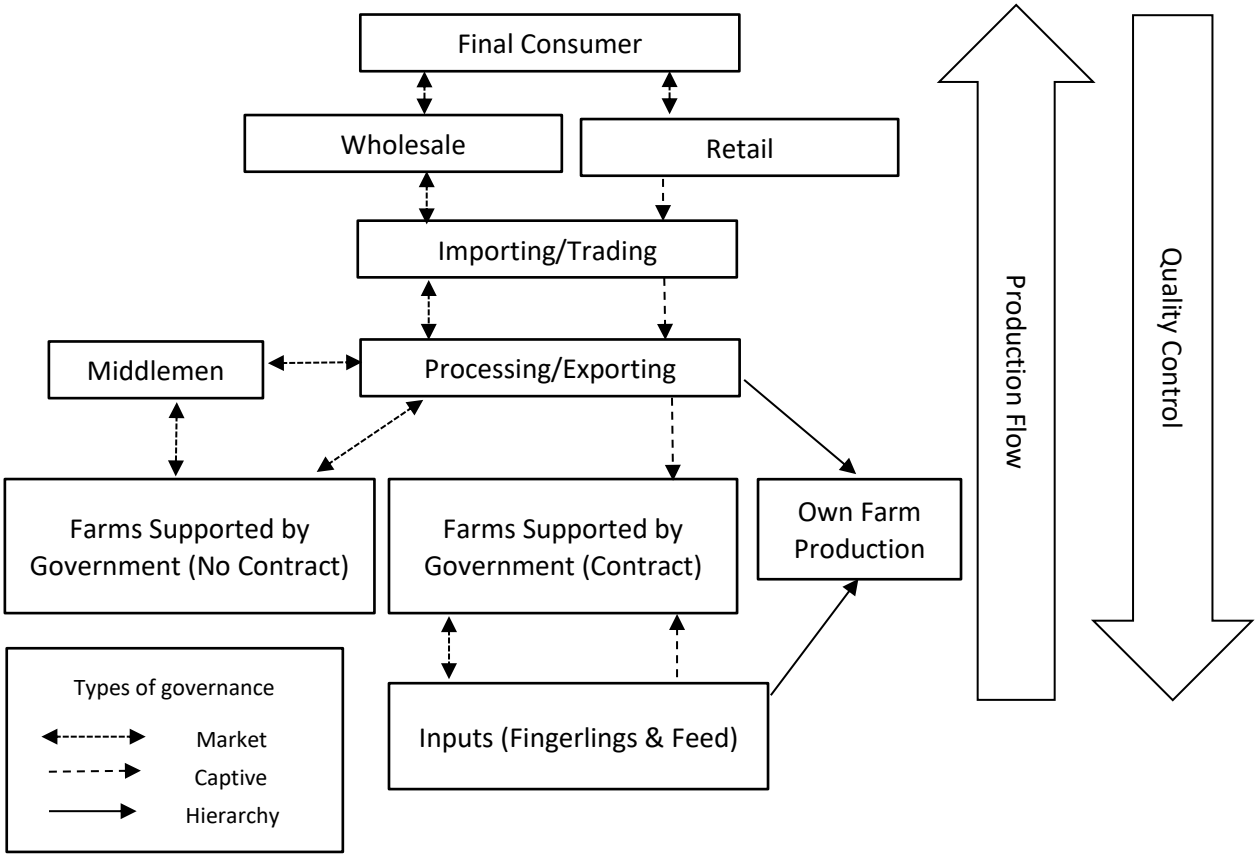


Figure 2-11 The Global Value Chain of Chinese Tilapia

Source: Adapted from Jespersen et al. (2014) and Ponte et al. (2014)

In the Vietnamese pangasius value chain, its governance characteristics are somewhat similar to the Chinese tilapia chain (multi-governance) (see Figure 2-12). For example, the relationship between the processors and importers is organised by market and captive relationships depending upon the end-market. Focusing on upgrading, since there is a lot of pressure from the EU and U.S. buyers' markets in terms of food safety standards, the trajectories in upgrading are based on those issues. For instance, Vietnam has tried to improve production and management practices (e.g., to increase yields and apply food safety standards to control production processes) (process upgrading). Vietnam also produces more sophisticated products such as pangasius fillets. The Vietnamese government has tried to promote GAP standard and Better Management Practices through national mandatory codes. However, this effort has been largely unsuccessful because of poor enforcement and a lack of relevant trade facilitation (Jespersen et al., 2014; Ponte et al., 2014).

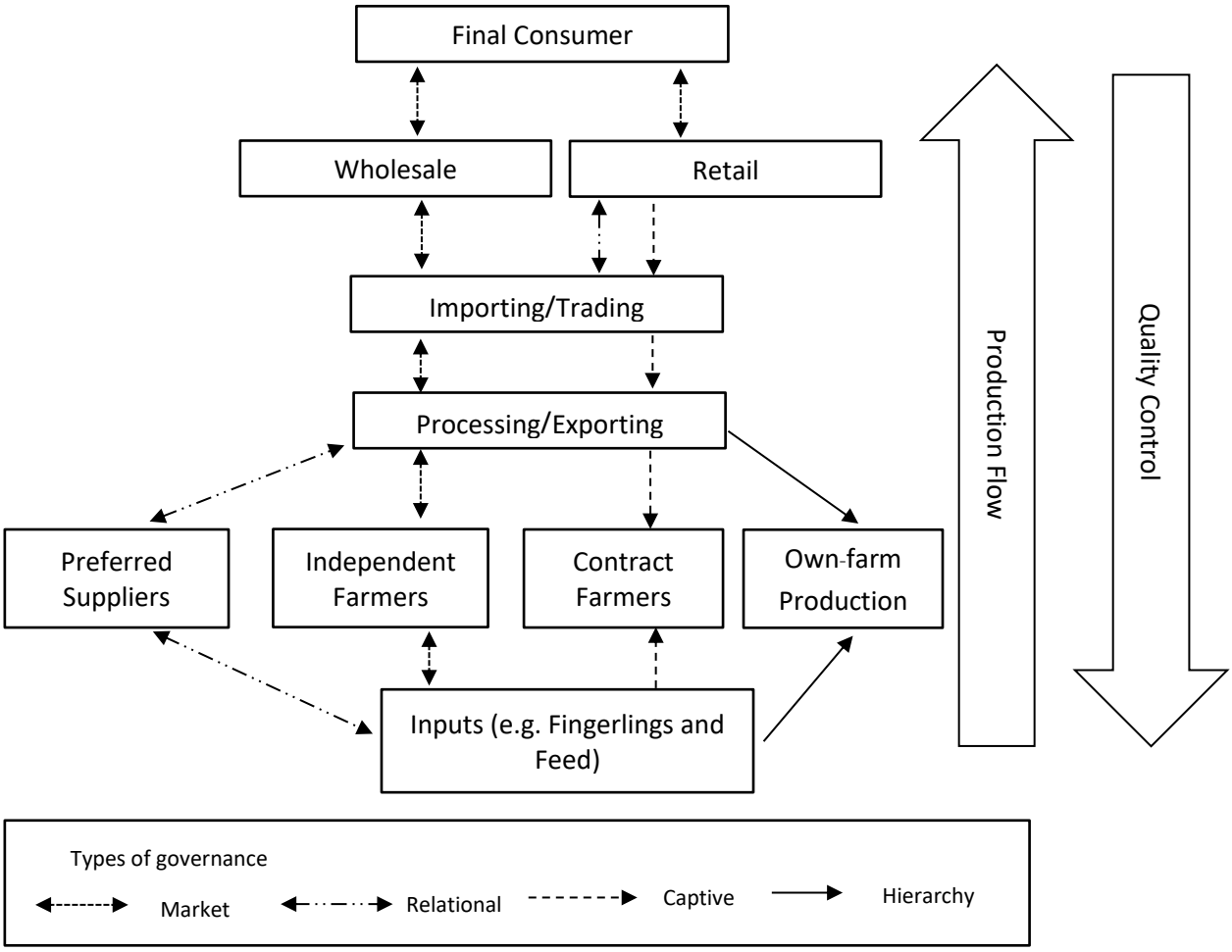


Figure 2-12 The Global Value Chain of Vietnamese Pangasius

Source: Adapted from Jespersen et al. (2014) and Ponte et al. (2014)

To sum up, applying the GVCs approach to the agri-food sector provides a complete picture of the relationships between relevant actors, such as producers, processors and exporters, in the chain. In terms of the top-down view, it shows the importance of the governance types used by the leading firm to control and monitor product quality. The bottom-up view, by contrast, explains the importance of upgrading for suppliers to keep their position or move up the value chain (Jespersen et al., 2014; Ponte & Ewert, 2009). There are numerous studies of GVCs in the agri-food sector (Jespersen et al., 2014; Ponte et al., 2014; Tran et al., 2013). It is interesting to note that the most important challenge in the agri-food value chain is how to meet food safety requirements. Unfortunately, some food safety standards become entry barriers. These standards can also negatively impact the agri-food exports of developing countries (Jaffee & Henson, 2004; Jongwanich, 2009). To understand how the agri-food sector operates in relation to GVCs, it is necessary to first understand how the leading firms govern their suppliers and how suppliers upgrade their production processes. The answers to these questions provide important information for creating suitable policies for the development of the agri-food sector.

2.5 Chapter Summary

The GVC approach has become a pivotal instrument to illustrate the relationship between actors within global production chains. There are two core components: governance and upgrading (Gereffi et al., 2005; Humphrey & Schmitz, 2002). Governance can be defined simply as non-market coordination of economic activities. In other words, it refers to the competence of leading firms in determining the production activities of other firms (suppliers) in the chain. Gereffi et al.'s (2005) work is central in governance types (Kadarusman & Nadvi, 2013; Ponte & Sturgeon, 2014; Wijk et al., 2008). According to Gereffi et al.'s (2005), there are five core types of governance: market, modular, relational, captive and hierarchical. Types differ depending on the complexity of transactions, the ability to codify transactions and the capability of suppliers.

Upgrading refers to economic activities that encourage firms or countries to shift from low-value activities, such as producing simple parts of products, to high-value activities. Upgrading is important to countries and firms since it enables them to maintain their position or move up the value chain (Barrientos et al., 2011; Pietrobelli, 2008). Upgrading is separated into two main types: economic (industrial) and social. Economic upgrading is categorised into four subtypes. Product upgrading takes place when producers produce sophisticated products. Process upgrading refers to transforming inputs to outputs more efficiently through the reorganisation of relevant production activities. Functional upgrading is when producers achieve new functions in the GVC. For instance, suppliers can change their role in a GVC bys moving from OEM to ODM and to OBM, or by moving from assembling players to distributors. Finally, inter-sectoral upgrading occurs when firms leverage knowledge acquired from a current chain to insert their business into a new industry (Bernhardt & Milberg, 2011a; Humphrey & Schmitz, 2002). Social upgrading refers to improvements in worker entitlements. It consists of measurable standards and non-measurable aspects. However, as the non-measurable aspects are somewhat difficult to quantify, most research focuses on measurable standards (Bernhardt, 2013; Bernhardt & Milberg, 2011a).

Understanding governance and upgrading in GVCs is important for countries and firms. In particular, it is important to understand how the value chain operates and how firms or countries can upgrade themselves within the chain. This leads to higher benefits. Most of the literature insists that participation in GVCs is significant for a country's development, such as boosting economic growth and increasing employment levels (Altenburg, 2006; Barrientos et al., 2011; Fernandez-Stark et al., 2012).

Previous studies investigated relevant policies that support or hinder participation in GVCs, including upgrading (Bamber et al., 2014; Shepherd & Wilson, 2009). Policies that support a country's development can be divided into five determinants: productive capacity, infrastructure and services, business environment, trade and investment policies, and industry institutionalisation. Productive

capacity is related to human resource development, R&D, and standard certification. Infrastructure and services refer to the development of transport, ICT, energy and water. The business environment refers to macroeconomic stability and public governance, the ease of opening a business and access to finance. Trade and investment policies refer to activities related to market access, tariffs, export-import procedures, border transition times and industry-specific policies, such as SEZs or related programmes. The last group, industrial institutionalisation refers to industry maturity and coordination, including public-private coordination.

Clearly, there is a myriad of products analysed using the GVCs approach. Scholars have been particularly interested in the agri-food sector (Jespersen et al., 2014; Ponte & Ewert, 2009; Tran et al., 2013). Overall, developed countries that act as global buyers and leading firms govern the GVCs in the agri-food sector. They employ various standards (such as food safety requirements) to control production. They use multiple types of governance (e,.g., hierarchical, captive, relational, and markets) (see Figure 2-13). Developing countries that act as suppliers to the chain must meet these standards. They need to upgrade their production processes to maintain their position or move up the GVC.

In sum, although participation in GVCs is essential for country development, there is no simple way to participate. Understanding how the value chain operates and how to upgrade ones' position in the chain is significant for countries that desire to insert themselves into GVCs. Because of the complexity of GVCs, it is impossible to find one method that suits all. How to insert oneself into a GVC is the focus of this study. It is important information for policymakers to enable them to create policies to support the efforts.

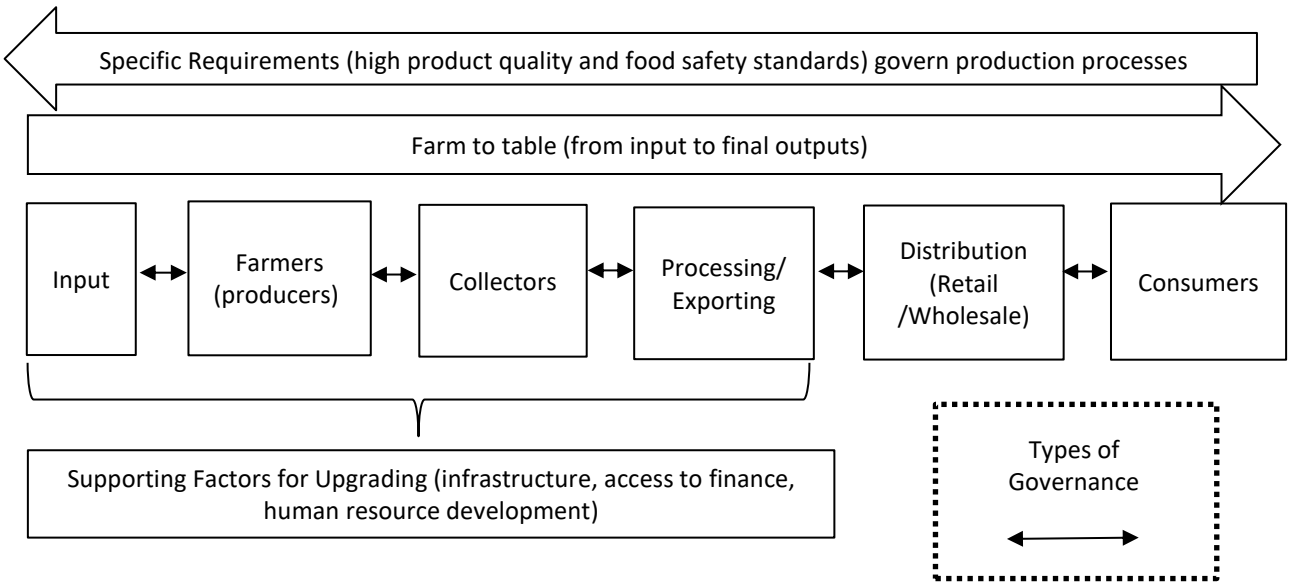


Figure 2-13 A Simple Example of an Agri-Food GVC

Source: adapted from Giovannetti and Marvasi (2016), Humphrey (2006), Jespersen et al. (2014), Ponte et al. (2014), Tran et al. (2013), Trienekens and Zuurbier (2008)

Chapter 3

The Structure of the Thai Processed Food Export Chain

This chapter provides background information on the TPFS and analyses TPFEs through the lens of GVC analysis. The chapter is divided into five sections. Section 3.1 gives an overview of TPFEs, i.e., trade performance and the production and business environment. The next section provides in-depth information about the export structure for the processed food. This is divided into two subparts: export composition and destinations. Section 3.3 presents an overview of the Thai processed foods value chains using GVC analysis. Section 3.4 analyses the export competitiveness of Thailand in the global processed food trade. Section 3.5 summarises the chapter.

3.1 An Overview of Thai Processed Food Exports

The Thai processed food industry has played a key role in the growth of the Thai economy over several decades. Processed food has become a significant export product for the Thai agricultural sector. These exports have replaced some of the classic export commodities such as rice and sugar. This occurred after changes to Thailand's trade policy in the mid-1980s, and the shift from IS to EP strategies. The TPFS has achieved remarkable competitiveness in the world market. Various product categories (both minimally processed food and manufactured food) of the sector have been placed at the top of world rankings. Those categories include processed shrimp, processed chicken, canned tuna and canned pineapple (Kasikorn Research Centre, 2016a; Kohpaiboon, 2006). This is because processed food production is a labour-intensive industry and Thailand is a country with an abundance of skilled workers. Against this backdrop, this study presents key information about the TPFS, focusing on an overview of trade performance and the production and business environment.

3.1.1 Trade Performance

Processed food export values have exhibited rapid growth from 1998 to 2016. The value has increased from 6,529.3 million U.S. dollars over 1998-2002, to 16,293.5 million U.S. dollars over 2013-2016 (see Table 3-1). Compared with other export products in the agri-food sector, processed food is outstanding in relation to export performance. Processed food exports' share in the agri-food sector accounted for 60% over 1998-2016 (see Table 3-1). In contrast, other traditional Thai export products (e.g., rice and tapioca), which had been key export products before the mid-1980s, have become a minor component of agri-food exports (see Table 3-1) (Kohpaiboon, 2006).

Developed countries (e.g., the U.S., Japan and the UK) have been the main export markets of the TPFS (see Figure 3-1 and Table 3-2). However, the percentage of TPFEs to developed nations has

continuously decreased, reducing from 75.69% of exports over 1998-2002 to 61.05% over 2013-2016. Conversely, developing countries have increased in importance as export markets. The ratio of TPFEs to developing nations in total TPFEs has increased from 24% over 1998-2002 to 37.8% over 2013-2016. This corresponds with the fact that when most developing countries face a slump in traditional export markets (developed countries), the developing nations tend to maintain their export competitiveness as much as possible through export diversification (exports to new destinations or exporting new products) (Lipsey, 2001; Tanrattanaphong, 2012). This was particularly true when Thailand was faced with the effects of the 2008 global financial crisis, which contributed to the world economic recession. This is a perfect example of Thailand being forced to diversify its processed food exports to developing countries (especially neighbouring countries) (see Table 3-2).

Table 3-1 Exported Product Composition of the Thai Agricultural Sector (1998-2016)

	1998-2002	2003-2007	2008-2012	2013-2016
	Export Value (U.S. dollars: Million)			
Total Exports	62,843.5	116,187.8	194,684.4	218,618.1
Non-agricultural Sector	48,341.8	91,560.1	148,274.4	169,499.4
Agricultural Sector	14,501.7	24,627.7	46,410.0	49,118.7
Agri-food	9,793.8	13,875.1	26,266.9	28,621.8
Rice	1,773.4	2,637.1	5,506.0	4,664.0
Tapioca	250.2	400.8	796.6	1,367.3
Processed Foods	6,529.3	8,821.9	14,969.0	16,293.5
Agricultural Raw Materials and Others	4,707.9	10,752.6	20,143.1	20,496.9
Rubber	2,414.9	7,055	14,806.8	13,828.7
	Comparative Proportion (per cent)			
Share of Non-Agricultural Sector in Total Exports	76.81	78.64	76.28	77.55
Share of Agricultural Sector in Total Exports	23.19	21.36	23.72	22.45
Share of Agri-food in Agricultural Sector	67.65	56.75	57.11	58.33
Share of Rice in Agri-food	18.13	18.92	21.36	16.27
Share of Tapioca in Agri-food	2.55	2.84	2.98	4.77
Share of Processed Food in Agri-food	66.66	63.80	57.09	57.02
Share of Rubber in Raw Materials and Others	50.95	64.85	72.69	67.21

Note: 1. The agri-food sector covers only agricultural products that are edible, both unprocessed and processed (rice, tapioca and processed food). In contrast, the agricultural sector covers agricultural products that are both edible and inedible (such as rubber and animal skins).
2. Product categories presented are classified by the Harmonized System 2002 (HS2002).
3. Processed food consists of meat products, dairy products, fish products, flour and cereals, vegetables, fruits (fresh or dried), eggs and egg products, sugar preparations and honey, coffee extracts, instant tea, cocoa-based products, other edible products and preparations and processed vegetable oils. See more details of processed food's definition in Appendix Table A-1.

Source: Author's computations from the Global Trade Atlas database and the UN Comtrade database

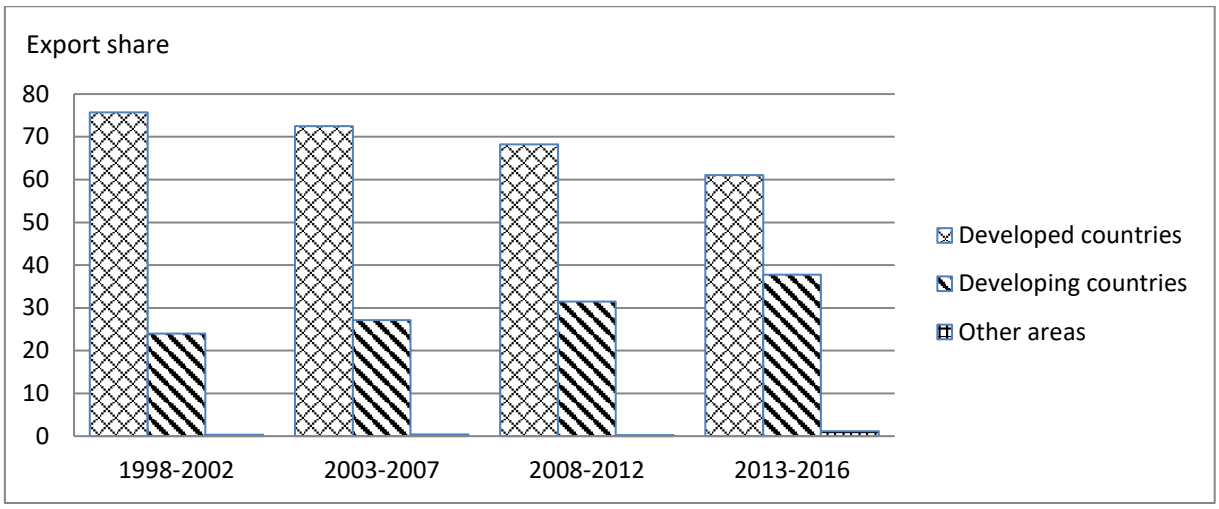


Figure 3-1 Export Destinations of Thai Processed Food Products (1998-2016)

Note: See Appendix Table B-1 for lists of developed and developing countries used in this study.
Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

Table 3-2 The Top 10 Export Markets for Thai Processed Food (1998-2016)

1998-2002	Export Share (%)	2003-2007	Export Share (%)
Japan	26.63	United States	24.02
United States	25.77	Japan	21.15
Singapore	4.09	United Kingdom	4.83
United Kingdom	3.42	Canada	3.24
Netherlands	3.34	Australia	3.20
Canada	3.23	Malaysia	3.07
Germany	3.09	Netherlands	2.96
Australia	3.08	Germany	2.67
Hong Kong	2.87	Hong Kong	2.30
Indonesia	2.21	Indonesia	2.13
2008-2012	Export Share (%)	2013-2016	Export Share (%)
Japan	19.62	Japan	18.80
United States	19.57	United States	15.73
United Kingdom	6.02	United Kingdom	5.78
Australia	3.37	Australia	3.81
Canada	3.05	China	3.57
Netherlands	2.71	Myanmar	3.55
Cambodia	2.54	Cambodia	3.21
Germany	2.22	Netherlands	3.07
Malaysia	2.12	Canada	2.71
Philippines	2.06	Malaysia	2.53

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

3.1.2 Production and the Business Environment

Production in the TPFS has been influenced primarily by multinational enterprises (MNEs). MNEs' involvement in the Thai processed food industry is usually in the form of MNE buyers. This history can be traced to the 1960s to 1980s when MNEs encouraged local Thai firms to begin processed food production (processed chicken, processed shrimp, canned tuna and canned pineapple). The entry of MNEs into the Thai processed food industry occurred in two ways: MNE affiliates and joint ventures

(Kohpaiboon, 2006). For instance, the Dole Co. Ltd (a U.S. affiliate) and Thai Pineapple Canning (a Taiwanese direct investor) provided export business opportunities to Thai entrepreneurs to commence production of canned pineapple. A second case is a Japanese joint venture and the Charoen Pokphand (CP) group that played a key role in developing intensive shrimp production in Thailand (Goss et al., 2000; Kohpaiboon, 2006). As a result of MNEs' involvement, new technology and knowledge have been shared within the TPFS. This has helped to improve local firms' production (both processes and outputs).

There are currently a few large Thai companies that are key producers of processed food; for instance, the CP group (which produces processed chicken and shrimp) and the Thai Union Frozen (TUF) group (which produces canned tuna). Most MNEs are buyers or act as multinational trading companies (Goss et al., 2000; Kuldilok, 2009, The Office of Industrial Economics, 2015). Most processed food products are produced for export; over 80% of Thailand's processed food products (TPFPs) are exported (processed shrimp, processed chicken, canned tuna and canned pineapple) (The Office of Industrial Economics, 2015). TPFPs are normally producing made-to-order products (Kohpaiboon, 2006).

Some Thai processed food companies acquire global brands. For instance, the TUF group, which produces canned tuna, acquired Chicken of the Sea (Kuldilok, 2009). Large Thai entrepreneurs in the processed food sector tend to invest in overseas countries to build sub-networks in the global network controlled by large MNEs. This is to capture higher benefits from GVCs. This practice is reflected in a significant increase of outward foreign direct investment (OFDI) in the TPFS; there was an increase from 7.2 million U.S. dollars in 1998 to 3,687 million U.S. dollars in 2016 (Bank of Thailand, 2017; The Office of Industrial Economics, 2015).

Most factories in the Thai processed food industry were small and medium-size factories (Kasikorn Research Centre, 2016a). They accounted for 97% of all factories; large factories accounted for only 3% (see Figure 3-2). Over recent several decades, the processed food sector has contributed to both Thai economic growth and increased employment levels. This is because the processed food sector is a labour-intensive industry. The number of labourers in the food industry has increased from 625,997 in 1998 to 1,387,183 in 2016, an increase of 55% (see Figure 3-3). There has also been an increase in monthly wages in the processed food industry, from an average of 2,378.5 Thai bath in 1998 to 10,269.3 Thai bath in 2016 (The National Statistical Office, 2017).

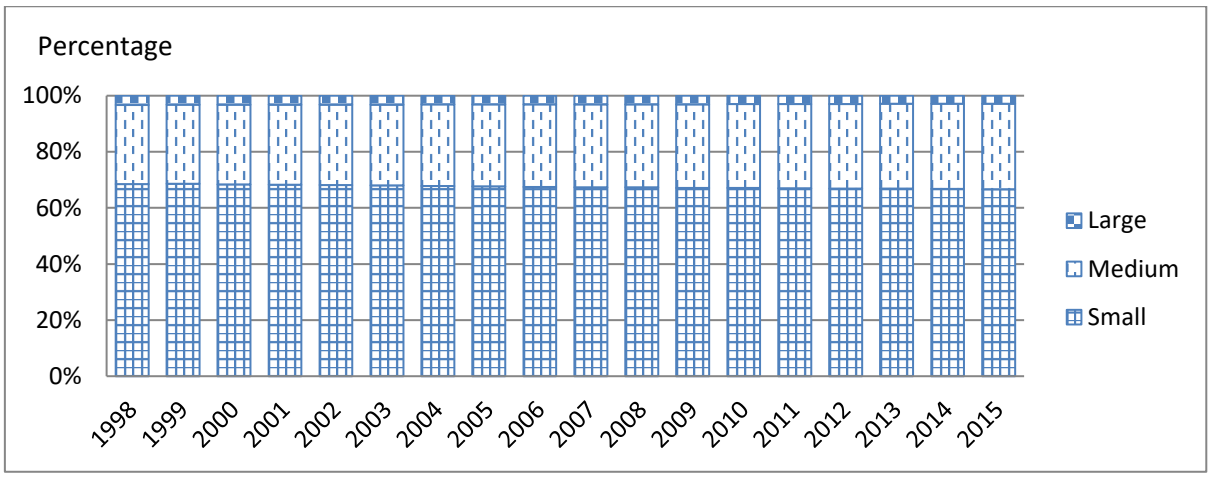


Figure 3-2 Proportion of Factories in the Thai Food Industry (1998-2015)

Note: A small factory refers to a factory with fewer than 50 workers. A medium factory is one with over 50 but fewer than 200 workers. A large factory has 200 or more workers.

Source: The Office of Industrial Economics (2017)

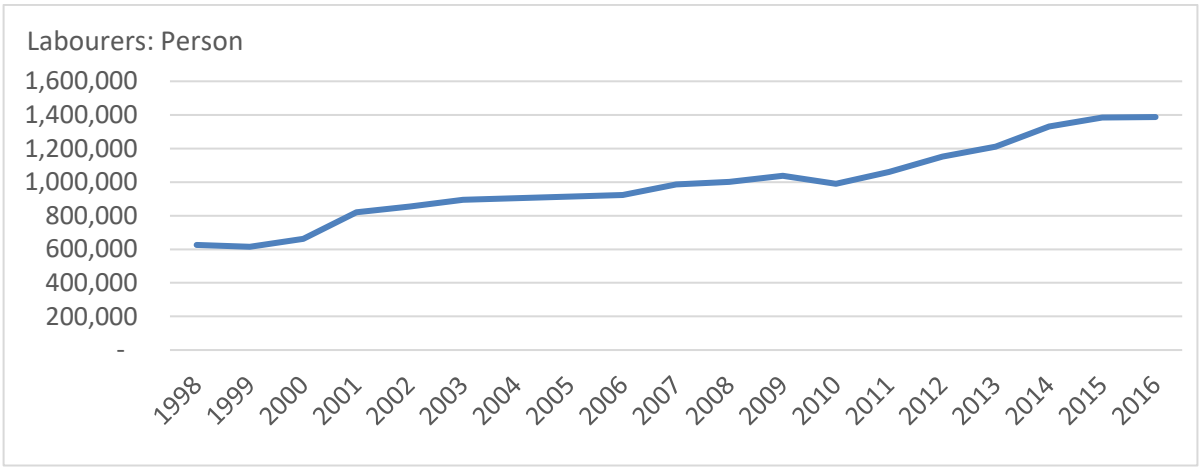


Figure 3-3 The Number of Labourers in the Thai Processed Food Industry (1998-2016)

Source: The National Statistical Office (2017)

3.2 Export Structure of the Thai Processed Food Sector

3.2.1 Composition of Exports

Over recent decades, TPFS export growth has been dominated by a few product categories, fish, meat and fruit products. Fish products ranked number one in the processed food sector from 1998 to 2016. The total export value of this product increased from 4,014.1 million U.S. dollars from 1998-2002, to 6,044.4 million U.S. dollars from 2013-2016, and accounted for approximately 50% of all exports (see Table 3-3). The importance of fish products as a key export product in processed food has been declining. The export share of fish products in the total processed food exports has dropped from 61.58% during 1998-2002, to 37.06% during 2013-2016 (see Table 3-4). Meat products and fruits (fresh and dried) export values have increased by approximately 2.4 times during the same period. The former group reached a striking export value; it increased from 841.1 million U.S. dollars during 1998-

2002 to 2,893.3 million U.S. dollars during 2013-2016. The export value of the latter group has risen from 549.3 million U.S. dollars to over 1,900 million U.S. dollars during the same period (see Table 3-3).

Table 3-3 Export Values of Thai Processed Food (1998-2016)

Unit: Million U.S. dollars

Product Group	1998-2002	2003-2007	2008-2012	2013-2016
Meat Products	841.1	1,029.1	2,106.6	2,893.3
Dairy Products	65.9	115.9	146.5	188.7
Fish Products	4,014.1	4,703.7	7,134.6	6,044.4
Flour and Cereals	129.1	181.9	372.8	548.3
Vegetables	173.9	249.9	318.5	342.9
Fruits, Fresh or Dried	549.3	979.7	1,543.6	1,905.2
Eggs and Egg Products	7.7	14.7	27.3	37.4
Sugar Preparations and Honey	337.6	597.0	1,378.9	1,596.7
Coffee Extracts, Instant Tea, Cocoa-based Products	24.0	81.8	215.3	253.9
Processed Vegetable Oils	2.5	2.1	8.3	12.8
Other Edible Products and Preparations	384.1	866.0	1,716.5	2,469.8

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

The export shares of meat products and fruits in the total agricultural, agri-food and processed food exports increased during 1998-2016. Meat products' export share in the agri-food sector increased from 8.59% during 1998-2002 to 10.11% during 2013-2016. Fruit products' export share of the agri-food sector rose from 5.61% to 6.66% during the same periods (see Table 3-4).

Other products (such as dairy, flour, cereals and vegetables) have continuously expanded since 1998. However, their export values have still been relatively minor compared with Thailand's top three processed food export products (fish, meat, and fruit products) (see Table 3-3). This is reflected in the export share for the other products in the TPFS being less than 10% (see Table 3-4).

Table 3-4 Thai Processed Food Exports: Comparative Data

Unit: %

Products	1998-2002			2003-2007			2008-2012			2013-2016		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Meat Products	5.80	8.59	12.83	4.18	7.42	11.72	4.54	8.02	14.04	5.89	10.11	17.77
Dairy Products	0.45	0.67	1.00	0.47	0.84	1.33	0.32	0.56	0.98	0.38	0.66	1.16
Fish Products	27.68	40.99	61.58	19.10	33.90	53.37	15.37	27.16	47.83	12.31	21.12	37.06
Flour and Cereals	0.89	1.32	1.98	0.74	1.31	2.06	0.80	1.42	2.48	1.12	1.92	3.37
Vegetables	1.20	1.78	2.67	1.01	1.80	2.83	0.69	1.21	2.15	0.70	1.20	2.10
Fruits, Fresh or Dried	3.79	5.61	8.40	3.98	7.06	11.08	3.33	5.88	10.36	3.88	6.66	11.70
Eggs and Egg Products	0.05	0.08	0.12	0.06	0.11	0.16	0.06	0.10	0.19	0.08	0.13	0.23
Sugar Preparations and Honey	2.33	3.45	5.16	2.42	4.30	6.76	2.97	5.25	9.12	3.25	5.58	9.81
Coffee Extracts, Instant Tea, Cocoa-based Products	0.17	0.25	0.37	0.33	0.59	0.92	0.46	0.82	1.42	0.52	0.89	1.56
Processed Vegetable Oils	0.02	0.03	0.04	0.01	0.02	0.02	0.02	0.03	0.06	0.03	0.04	0.08
Other Edible Products and	2.65	3.92	5.86	3.52	6.24	9.76	3.70	6.54	11.38	5.03	8.63	15.16

Note: (1) refers to the share of a given product group in Thai agricultural products
(2) refers to the share of a given product group in Thai agri-food products
(3) refers to the share of a given product group in Thai processed food products

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

Focusing on some key export products of TPFS, the Thai processed shrimp export value has fluctuated because of several factors. The first is related to the economic recession. It resulted in decreased consumption in developed countries that are key consumers in global markets. In addition, the Thai processed shrimp industry faced some severe situations.[12] In particular, shrimp production in Thailand suffered from an outbreak of EMS during 2012-2014. This reduced shrimp yields and raised some concerns about the food safety standards of Thai shrimp products (Kasikorn Research Centre, 2016a; The Office of Industrial Economics, 2015). As a result, the Thai processed shrimp export value dropped from 3,104.7 million U.S. dollars in 2012 to 1,667.6 million U.S. dollars in 2015 (see Figure 3-4). This product's average export share in the agricultural, agri-food, and processed food sectors of 8.38%, 13.69% and 21.96%, respectively, during 1998-2016. However, the processed shrimp export share in those sectors has noticeably decreased. For instance, the share of the processed food sector dropped from 33.72% during 1998-2002 to 12.13% during 2013-2016 (see Table 3-5).

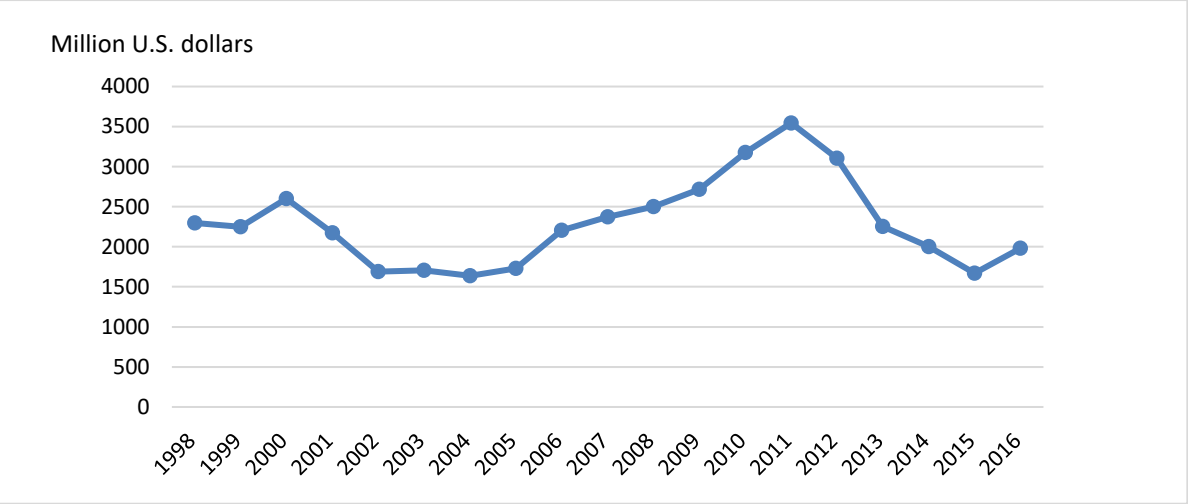


Figure 3-4 Thai Processed Shrimp Export Values 1998 to 2016

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

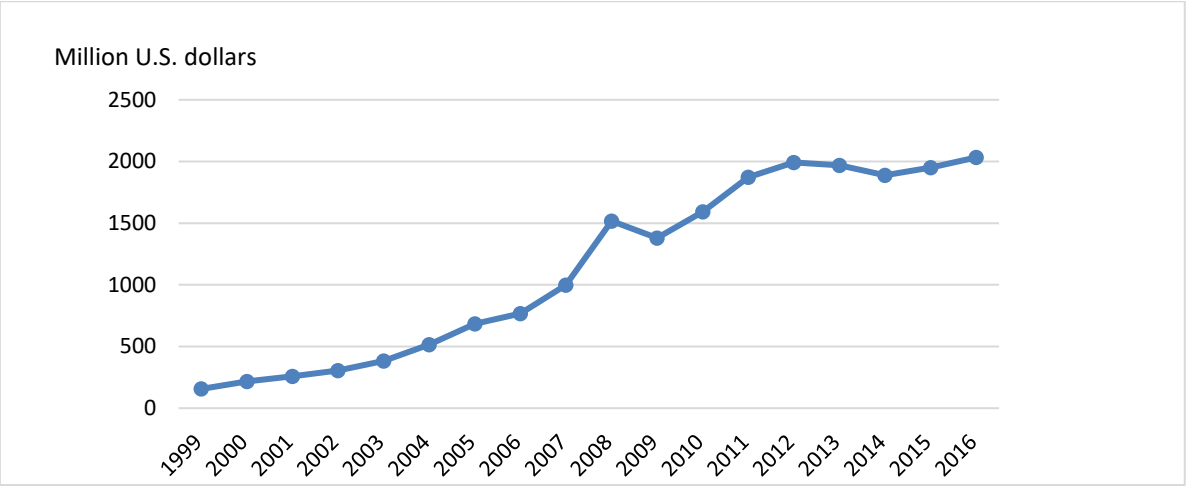
[12] Thailand has faced other serious situations, such as illegal unreported and unregulated fishing (IUU Fishing) and the loss of the Generalised System of Privileges (GSP). However, these events have a negative minor impact on Thai shrimp exports. This is becasue most shrimp production in Thailand is shrimp farming. The IUU problem has a strong negative impact on natural fishing. The loss of the GSP also affects Thai shrimp exports for a short period of time. In the long term, shrimp exporting countries have to pay the normal tariff rates in the world market (The Office of Industrial Economics, 2015).

Table 3-5 Key Export Products of the Thai Processed Food Sector: Comparative Data

Comparative Data	1998-2002	2003-2007	2008-2012	2013-2016
Share of a given product in agricultural products	%	%	%	%
Processed Shrimp	15.18	7.84	6.46	4.02
Processed Chicken*	1.62	2.72	3.60	3.99
Canned Tuna	4.37	4.58	4.50	4.54
Canned Pineapple	1.56	1.41	1.15	1.10
Share of a given product in agri-food products	%	%	%	%
Processed Shrimp	22.48	13.91	11.45	6.90
Processed Chicken*	2.40	4.83	6.36	6.85
Canned Tuna	6.48	8.13	7.96	7.78
Canned Pineapple	2.31	2.51	2.04	1.89
Share of a given product in processed food products	%	%	%	%
Processed Shrimp	33.72	21.88	20.10	12.13
Processed Chicken*	3.59	7.59	11.16	12.03
Canned Tuna	9.72	12.79	13.96	13.67
Canned Pineapple	3.47	3.95	3.58	3.32

Note: * Export values of processed chicken are not available for 1998.
Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

In contrast, the export value of processed chicken has achieved a predominantly upward trend during 1998-2016 even though Thailand was confronted by the world economic recession, new trade barriers, and the avian bird flu epidemic (2004 - 2005) (Krungsri Research, 2016). The export share of this product in the agricultural, agri-food and processed food sectors has continually increased. As illustrated in Table 3-5, the processed chickens export share of agricultural export products increased from 1.62% during 1998-2002 to 3.99% during 2013-2016 (see Table 3-5). Because of the bird flu outbreak, all unprocessed forms of chicken (i.e., fresh, chilled or frozen) were prohibited. To overcome this problem, Thailand began to produce processed forms of chicken (Krungsri Research, 2016). This led to a striking increase in the processed chicken export value from 684.3 million U.S. dollars in 2005 to nearly 1,900 million U.S. dollars in 2011 (see Figure 3-5). However, processed chicken export growth slowed between 2011 and 2016 as Thailand faced higher competition in global markets. In particular, the EU, a key buyer of processed chicken, applied tariff and non-tariff measures. Thailand has gained an export quota for processed chicken from the EU of approximately 160,033 tonnes/year with a tariff rate about 8%. Excess exports beyond the quota suffer a huge tariff rate, approximately €1,024 euro/tonne. This practice became one key barrier to the expansion of Thai processed chicken (Thailand's Office of Agricultural Affairs, 2016).



Note: Export values of processed chicken are not available for 1998.

Figure 3-5 Thai Processed Chicken Export Values 1998 to 2016

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

Another key export product is canned tuna. The export value of this product continuously increased between 1998 and 2016, even though Thailand suffered the effects of the world economic recession and an increase in the cost of raw tuna (Hamilton et al., 2011; Kohpaiboon, 2006). This is reflected in a noticeable increase in the export value of this product from 683 million U.S. dollars in 1998 to 1,979 million U.S. dollars in 2016 (see Figure 3-6). Canned tuna exports' share of the agricultural, agri-food, and processed food sectors slightly increased during 1998-2016. For instance, the export share of the agricultural sector increased from 4.37% during 1998-2002 to 4.54% during 2013-2016. The exports' share of canned tuna in the agri-food and processed food sectors has continuously increased from 6.48% to 7.78% and 9.72% to 13.67%, respectively, at the same time (see Table 3-5).

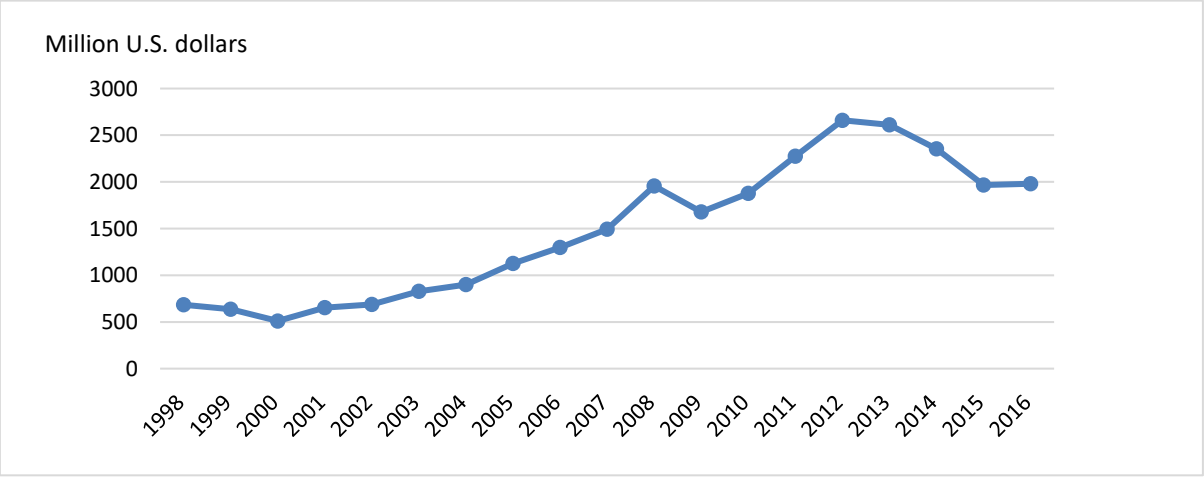


Figure 3-6 Thai Canned Tuna Export Values 1998 to 2016

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

Canned pineapple achieved an upward trend between 1998 and 2016, despite some fluctuations (see Figure 3-7). Some reasons include the world economic recession, a reduction in land available for the

cultivation of pineapple in Thailand, and decreased yields (Kasikorn Research Centre, 2016a; Kohpaiboon, 2006). These effects are reflected in a decrease in canned pineapple export value after the onset of the Asian financial crisis during 1997-1998. The value dropped from an average of 314.8 million U.S. dollars in 1999 to an average of 214.6 million U.S. dollars during 2000-2002. The export value climbed again between 2002 and 2006, from 224.3 million U.S. dollars in 2002 to 378.6 million U.S. dollars in 2006. However, fluctuations in export value recurred during 2008-2016. The export value decreased between 2008 and 2009 then increased again between 2009 and 2011 (see Figure 3-7). Canned pineapple exports' share of the agricultural, agri-food, and processed food sectors slightly decreased between 1998 and 2016, from 3.47% during 1998-2002 to 3.32% during 2013-2016 (see Table 3-5).

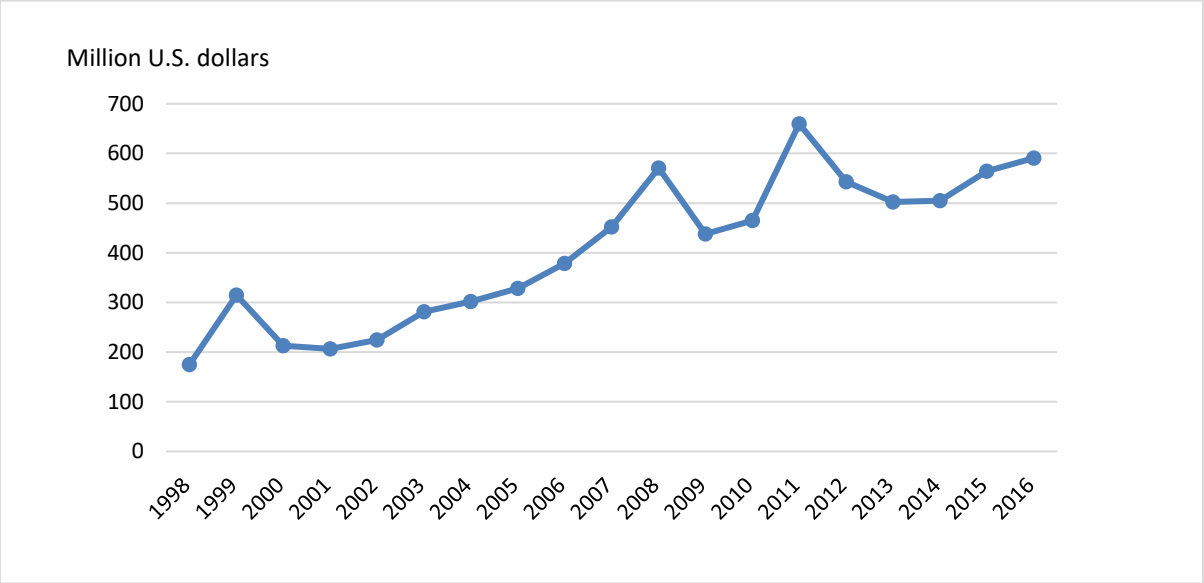


Figure 3-7 Thai Canned Pineapple Export Values 1998 to 2016

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

3.2.2 Export Destinations

During 1998-2016, both developed and developing nations were key importers of TPFPs. Japan, the U.S., and the EU were primary importers of Thai meat and fish products, vegetables and fruit. Thai meat and fish products exported to the top three export partners (Japan, the Netherlands, and the U.K.) accounted for 78.25% and 57.8%, respectively (see Table 3-6). Developing countries imported other product categories, including, dairy products, sugar preparations and honey, and processed vegetable oils. ASEAN countries are the core importers of Thai dairy products; nearly 60% of exports of this product group was exported to Malaysia, the Philippines and Cambodia. Some product categories (flour and cereals, egg products, coffee extracts, instant tea, cocoa-based products, and other edible products and preparations) are exported not only to developed countries but also developing ones (see Table 3-6).

Table 3-6 The Major Export Markets of the Thai Processed Food Sector by Product Group

Product Group	1998-2002	2003-2007	2008-2012	2013-2016
Meat Products	Japan (53.1%)	Japan (48.5%)	Japan (47.6%)	Japan (47.88%)
	Netherlands (11.2%)	UK (22.9%)	UK (25.1%)	UK (20.7%)
	Germany (11.2%)	Netherlands (8.1%)	Netherlands (7.4%)	Netherlands (9.3%)
Dairy Products	Malaysia (24.4%)	Philippines (26.4%)	Cambodia (26.5%)	Cambodia (29.1%)
	Philippines (19.7%)	Cambodia (16.5%)	Singapore (16.9%)	Singapore (17.3%)
	Cambodia (17.2%)	Malaysia (10.8%)	Laos (15.3%)	Laos (15.3%)
Fish Products	U.S. (35.2%)	U.S. (33.9%)	U.S. (29.6%)	U.S. (23.7%)
	Japan (26.1%)	Japan (22.7%)	Japan (20.7%)	Japan (19.8%)
	Singapore (4.7%)	Canada (4.6%)	Canada (4.7%)	Australia (5.6%)
Flour and Cereals	Japan (31.6%)	Japan (19.9%)	Japan (13.6%)	U.S. (10.3%)
	Hong Kong (8.8%)	Hong Kong (8.8%)	U.S. (9.3%)	Japan (8.5%)
	Malaysia (7.7%)	U.S. (8.3%)	Cambodia (8.0%)	Myanmar (7.8%)
Vegetables	Japan (35.1%)	Japan (22.5%)	Japan (17.3%)	Japan (17.9%)
	U.S. (17.3%)	U.S. (13.9%)	U.S. (12.8%)	U.S. (11.3%)
	UK (4.7%)	UK (7.9%)	UK (5.6%)	South Korea (6.0%)
Fruits, Fresh or Dried	U.S. (28.5%)	U.S. (36.0%)	U.S. (32.9%)	U.S. (34.8%)
	Netherlands (10.9%)	Netherlands (9.6%)	Netherlands (7.9%)	Japan (5.8%)
	Japan (8.3%)	Japan (6.1%)	Japan (6.4%)	Netherlands (4.6%)
Eggs and Egg Products	Japan (36.4%)	Hong Kong (55.1%)	Hong Kong (50.7%)	Hong Kong (60.6%)
	Hong Kong (23.4%)	Japan (22.2%)	Japan (22.0%)	Japan (19.9%)
	U.S. (9.5%)	U.S. (5.5%)	Angola (11.2%)	U.S. (6.2%)
Sugar Preparations and Honey	Indonesia (39.1%)	Indonesia (25.5%)	Cambodia (10.4%)	Cambodia (15.5%)
	Cambodia (9.4%)	Cambodia (10.4%)	Indonesia (8.9%)	Myanmar (11.2%)
	Malaysia (4.2%)	Malaysia (6.0%)	Iraq (8.8%)	China (10.2%)
Coffee Extracts, Instant Tea, Cocoa-based Products	U.S. (19.3%)	Turkey (14.6%)	Myanmar (24.1%)	Myanmar (25.2%)
	Australia (16.6%)	Netherlands (12.6%)	Laos (10.7%)	Laos (11.2%)
	Japan (16.1%)	Laos (8.2%)	France (10.2%)	Cambodia (9.7%)
Processed Vegetable Oils	Indonesia (35.6%)	Indonesia (58.4%)	Indonesia (25.0%)	China (46.8%)
	Myanmar (10.3%)	Japan (6.9%)	Pakistan (21.6%)	Indonesia (17.8%)
	South Korea (9.7%)	Australia (6.1%)	China (11.3%)	Myanmar (12.5%)
Other Edible Products and Preparations	Japan (22.5%)	Japan (14.6%)	U.S. (12.3%)	U.S. (12.8%)
	U.S. (15.8%)	Malaysia (12.5%)	Japan (11.4%)	Myanmar (8.8%)
	Hong Kong (7.8%)	U.S. (12.0%)	Philippines (9.3%)	Japan (8.1%)

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

Thai processed shrimp, processed chicken, canned tuna, and canned pineapple are usually exported to developed nations. As illustrated in Table 3-7, about 70% of the total exports of Thai processed shrimp have been exported to the U.S., Japan and Canada. Thai processed chicken was exported mainly to Japan, the UK and the Netherlands which were the top three trading partners of this product between 1998 and 2016. The exports of this product to those countries accounted for about 84% of total Thai processed chicken exports over the period of 1998 – 2016. Thai canned tuna products were exported to some developed nations, the same as processed shrimp and processed chicken. About 40% of total exports of canned tuna were sent to the US, Australian and Japanese markets. Likewise, Thai canned pineapple has been mostly exported to the U.S., Germany, the Netherlands and Japan over the period of 1998-2016. In short, the U.S. and Germany have been core trading partners in Thai canned pineapple exports. More than 30% of Thai canned pineapple was exported to the U.S and Germany between 1998 and 2016 (see Table 3-7).

Table 3-7 Major Export Markets of the Thai Processed Foods Sector: Key Specific Products

Product	1998-2002	2003-2007	2008-2012	2013-2016
Processed Shrimp	U.S. (49.85%) Japan (22.42%) Singapore (6.20%)	U.S. (56.02%) Japan (20.65%) Canada (5.96%)	U.S. (46.13%) Japan (22.11%) Canada (5.96%)	U.S. (42.38%) Japan (24.56%) Canada (5.24%)
Processed Chicken*	Japan (31.14%) UK (29.40%) Netherlands (22.65%)	Japan (43.31%) UK (30.93%) Netherlands (9.97%)	Japan (48.43%) UK (29.18%) Netherlands (7.34%)	Japan (49.83%) UK (27.18%) Netherlands (6.29%)
Canned Tuna	U.S. (29.26%) Canada (9.10%) Japan (8.91%)	U.S. (24.28%) Japan (8.47%) Australia (8.31%)	U.S. (22.39%) Australia (8.61%) Japan (7.26%)	U.S. (18.21%) Australia (8.89%) Japan (7.76%)
Canned Pineapple	U.S. (21.21%) Germany (12.92%) Japan (8.91%)	U.S. (26.39%) Germany (7.83%) Netherlands (6.35%)	U.S. (26.89%) Germany (7.38%) Netherlands (4.71%)	U.S. (31.74%) Germany (6.47%) Russia (4.09%)

Note: *Export values of processed chicken are not available for 1998.
Source: Author's computation from the Global Trade Atlas and the UN Comtrade database

3.3 Implications of the GVCs for the Thai Processed Food Sector

To provide a more complete picture of GVCs' implications for TPFS, this section presents the GVCs associated with some specific products of Thailand's processed food industry. Those products are: processed shrimp, processed chicken, canned tuna and canned pineapple. In particular, the governance concept is used to explain how MNEs and global buyers control production processes through the value chains of these products.

3.3.1 Processed Shrimp

The Thai processed shrimp industry is inserted into the GVC through collaboration between large agribusiness firms in the industry and foreign firms. As Thailand lacked the necessary technology to run intensive shrimp farms[13] during the mid-1980s, the CP Group created a joint venture with the Mitsubishi Corporation (a Japanese firm), called CP aquaculture. CP aquaculture hired Taiwanese technicians with experience in intensive shrimp farming to provide breeding knowledge (The Asia Foundation and International Labour Organisation, 2015; Kohpaiboon, 2006; Tapanya & Udomkit, 2017).

Shrimp exports rely heavily on MNE buyers' channels. Global consumers propose a myriad of requirements and product standards to control product quality. To illustrate the governance forms in Thai processed shrimp value chain, it is important to look at three stages: upstream, midstream, and downstream (see Figure 3-8). The upstream stage relates to pure shrimp line imports and shrimp larvae production. Captive governance is usually seen at this stage. This is because there are only a few large players with the high competencies at this stage. Other players are characterised as low competency suppliers. Evidently, most pure breeding lines of shrimp (white-leg breeding lines that are pathogen-free) are imported, especially from the U.S., to produce shrimp larvae (The Office of Industrial Economics, 2015). Importation depends on a few Thai agribusiness firms, such as the CP and TUF groups that, at this stage, have more bargaining power than other stakeholders, such as nursery and grow-out farms. After importing, the shrimp larvae are raised by hatchery farms that normally belong to large companies. This is to control the quality of the breeding lines; a significant amount of investment is required to run the hatcheries. As a result, large companies that can produce disease-resistant strains have had a significant advantage in this business (The Asia Foundation and International Labour Organisation, 2015). The offspring are then transported to nursery and grow-out farms. There are currently about 1,000 nursery farms and 10,000 grow-out farms in Thailand (The Asia Foundation and International Labour Organisation, 2015). Grow-out farms can be divided into three categories: independent farms, contract farms, and integrated farms. These farms (i.e., hatcheries, nurseries and grow-out farms) usually depend on support from large companies, such as finance and chemical companies, to run their business (The Asia Foundation and International Labour Organisation, 2015; Product Marketing Strategy Department, 2015) (see Figure 3-8).

[13] Shrimp farms can be divided into two key types: extensive and intensive. Extensive farming refers to uncontrolled farming with limited areas (cultivated in coastal areas only). There is little regulation of water quality and feeding is negligible. Intensive farming, in contrast, is a controllable farm with large-inland areas. Additionally, the quality of input factors (such as water and feed) are strictly controlled. Intensive farm yields are much higher than those of extensive farms (Kohpaiboon, 2006).

Once shrimp larvae have reached a marketable size (approximately 100 days), they are distributed to shrimp agents/brokers and processors. This stage is the connection between the upstream and the midstream. Various forms of governance are employed, such as market, relational, captive, and hierarchical forms. The type depends on the characteristic economic transactions between farmers, agents/brokers, and processors. Normally, farmers are not obliged to sell their product to processors although they gain assistance from those processors. They tend to sell their product to whoever provides the highest price via the auction channel. Market coordination is a key form of governance in these transactions. The product price plays a key role in deal-making (Jespersen et al., 2014). However, the economic transactions between some grow-out farms and some large processors is classified as other forms of governance, relational, captive and hierarchical. For instance, some large processors (almost) fully control production. The captive form explains that relationship. In addition, some large processors and some farmers have a long-term relationship characterised by mutual dependence (the relational form). Some global processors use a hierarchical form of governance to control processed shrimp value chains. For example, the CP group controls all product processes with integrated farms to meet consumer requirements around production, labour and environmental standards (The Asia Foundation and International Labour Organisation, 2015; Goss et al., 2000; Kohpaiboon, 2006) (see Figure 3-8).

Raw shrimp products are normally distributed from agents/brokers or primary processors to secondary processors. There are two main types of governance at this stage. The coordination between agents/brokers and secondary processors is described as a form of market coordination. This is because the agents/brokers make a deal with secondary processors. Here the product price is critical. Shrimp products are distributed from the agents/brokers to secondary processors in the raw form (whole shrimp). Coordination between primary and secondary processors can be seen as a form of captive governance. Normally, primary processors are responsible for simple processing, sorting, peeling and head removal. These activities depend on the secondary processors' requirements (The Office of Industrial Economics, 2015). Once the raw shrimp products (both whole shrimp and simple processed products) are gathered by secondary processors, those processors (some of whom are exporters) produce processed shrimp products to meet consumer demand. The final products are in simple form (frozen and chilled products) and complex ones (shrimp wonton soup and prawn fried rice). They depend on the ability of each processor, the importer's requirements and the consumers. These processes can be described as modular and captive forms of governance. Interestingly, some large Thai enterprises acquire global companies to enhance their distribution and market channels in developed countries where there are significant export markets for Thai processed shrimp. For instance, TUF acquired Chicken of the Sea Frozen Foods (one of the two largest importers/marketers of frozen shrimps in the U.S. market). TUF exerts a high control level over the shrimp value chain, both

domestically and overseas (The Asia Foundation and International Labour Organisation, 2015; Thai Union Group Public Company Limited, 2016). In short, TUF uses vertical integration to ensure market access (see Figure 3-8).

In the final part of the processed shrimp value chain, processed shrimp products are distributed from importers/distributors to consumers. Multi-forms of governance are evident at this stage. For example, the coordination that occurs between importers/distributors and consumers in Japan and the U.K. can be seen as a form of relational coordination. For Japan, there are many requirements that complex processed products must meet. Consequently, there is a high degree of mutual dependence between importers/distributors and consumers. For the U.K. market, relational coordination relies on verbal agreements and trusted relationships among stakeholders, the importers/distributors, retailers and the foodservice industry. In contrast, coordination between importers/distributors and consumers in the U.S. market seems to be a captive form of governance since most Thai processed shrimp products sold in the U.S. depend heavily on large retailers (such as Wal-Mart), or made-to-order products, called OEM (Jespersen et al., 2014; Kohpaiboon, 2006; Thai Union Group Public Company Limited, 2016).

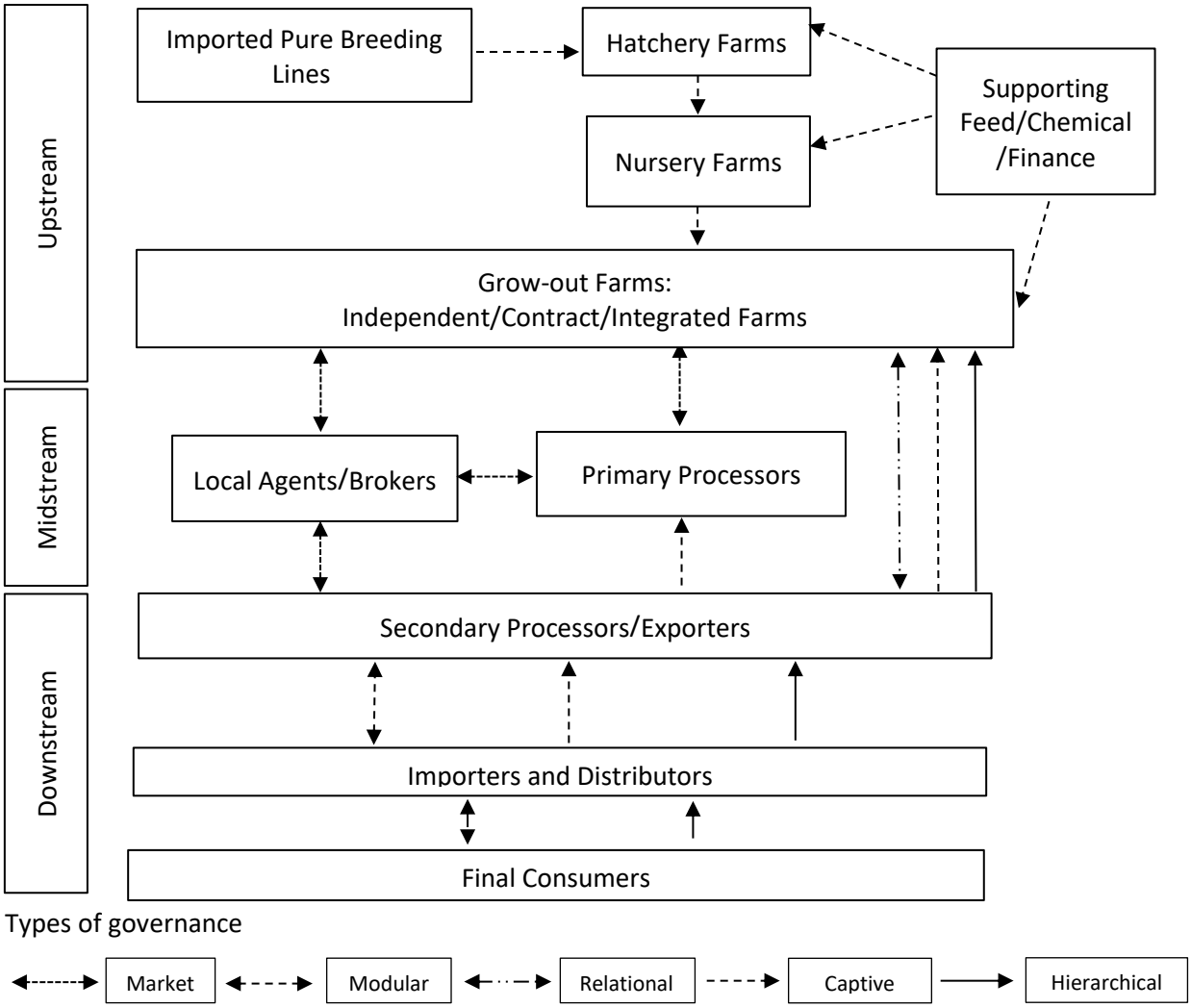


Figure 3-8 The Global Value Chain of Thai Processed Shrimp

Source: Summarised by the author

3.3.2 Processed Chicken

The history of the Thai processed chicken industry's participation in GVCs is somewhat like the Thai processed shrimp industry. When the CP group (a large Thai entrepreneur) created a joint venture with the U.S. firm International Basic Economy Corporation, Arbor Acres Farm Inc. was established as a joint venture to provide advanced, relevant technology to chicken breeding and feeding firms in Thai chicken industry. MNE buyers, who are mostly European and Japanese, have assisted Thai chicken producers to meet consumer demand and comply with regulations (Heft-Neal et al., 2008; Kohpaiboon, 2006).

After the establishment of the Arbor Acres Farm Inc., Thailand became a key exporter of chicken products to global markets, mostly in raw form (frozen or chilled). The Thai chicken industry was impacted by the bird flu outbreak between 2004 and 2005. Raw chicken products from Thailand were totally banned by developed countries. Food safety standards were introduced to ensure the quality

of Thai chicken products for export. As a result, there were significant structural changes in the Thai chicken industry. For example, Thai chicken farms have increased in size to take advantage of economies of scale and greater levels of investment and now use evaporative cooling systems (EVAPs) to control production at the farm level (Heft-Neal et al., 2008; Kohpaiboon, 2006; Krungsri Research, 2017). The EVAPs are used to control the temperature in farms where animals are housed. This system helps to reduce diseases and animal death rates. Farmers can also effectively control animal weight and chicken numbers (Heft-Neal et al., 2008; Krungsri Research, 2017). Finally, raw chicken products have been replaced by processed ones. Thailand has become a significant global exporter of processed chicken (Thailand Development Research Institute, 2010).

There are three main stages in the Thai chicken value chain: upstream, midstream and downstream (see Figure 3-9). A schematic overview of the value chain of processed chicken is less complicated than the value chain of processed shrimp. There are only a few key stakeholders, especially large agribusiness companies (such as the CP group, Betagro and Cargill). These companies control most activities related to the production of processed chicken. As a result, captive and hierarchical forms of governance dominate. Upstream, Thai breeding farms import good quality grandparent stocks from the U.S. or the EU to produce their parent stocks. The coordination between foreign breeding companies and Thai-breeding farms is captive governance since Thai breeding farms lack the ability to produce high-quality grandparent stocks. As a result, Thai-breeding farms significantly depend on foreign companies from which to import grandparent stocks (Heft-Neal et al., 2008). Once they have imported grandparent stocks, breeding farms produce parent stocks. These are distributed to the hatchery farms that produce chicks. The relationship between local breeding farms and hatchery farms is classified as hierarchical governance. This is because large agribusiness companies in the Thai chicken industry have their own breeding and hatchery farms. After day-old-chicks are produced, they are distributed to broiler farms. These can be one of two categories contract farms and company farms. The relationship between contract farms and hatchery farms is captive governance. Contract farms take responsibility only for raising day-old-chicks. They are given some assistance, e.g., vaccines, and financial support, by large companies (Krungsri Research, 2017). In addition, larger companies provide the contract farms with education about new techniques and advanced technology (e.g., EVAPs). Large companies establish their own broiler farms and control all activities (Heft-Neal et al., 2008; Kohpaiboon, 2006; Thailand Development Research Institute, 2010). The governance form at this stage is then hierarchical.

The midstream connection between broiler farms and the slaughterhouses operated by large companies is presented in Figure 3-9. When broiler chickens reach the marketable weight and size, they are sent to slaughterhouses. Only large companies take full responsibility for running these businesses since there are many food safety standards, animal-welfare issues, and Halal standards to

meet. A significant amount of investment is needed to meet the standards. Consequently, only large companies can reach them (Heft-Neal et al., 2008). There are two forms of governance at this stage: captive and hierarchical. The first form covers the connection between contract farms and slaughterhouses. Contract farms rely on the slaughterhouses since they do not have the necessary facilities to slaughter their own chickens. The second form of governance applies to the connection between company farms and slaughterhouses. Large companies fully control the activities of their slaughterhouses and chicken farms to ensure product quality (Kohpaiboon, 2006).

The connection between midstream and downstream occurs in transactions between the slaughterhouses and the processing plants (see Figure 3-9). Both streams are operated by large companies, the CP group, Betagro, and Cargill (Heft-Neal et al., 2008). Consequently, the governance form is hierarchical. The main downstream activities relate to the distribution of processed chicken to the consumers who are usually Japanese and European (Krungsri Research, 2017; Thailand Development Research Institute, 2010). The processed chicken is mainly “made-to-order” products. Processed chicken exported to Japan is produced with a high degree of product differentiation, ascending from simple forms (e.g., portion cuts like chicken breast) to more complicated products, mostly in the form of ready to cook/eat products. These include steamed and diced chicken and roasted chicken. By contrast, European people prefer simple processed products, namely cutlets and steamed chicken. Buyers and importers provide clear guidelines about food safety standards. Thai processing firms, Thai exporters and importers have long-term relationships characterised by mutual dependence to achieve the objectives. Forms of governance at the downstream level can be both relational and captive (Heft-Neal et al., 2008; Kasikorn Research Centre, 2016a; Kohpaiboon, 2006).

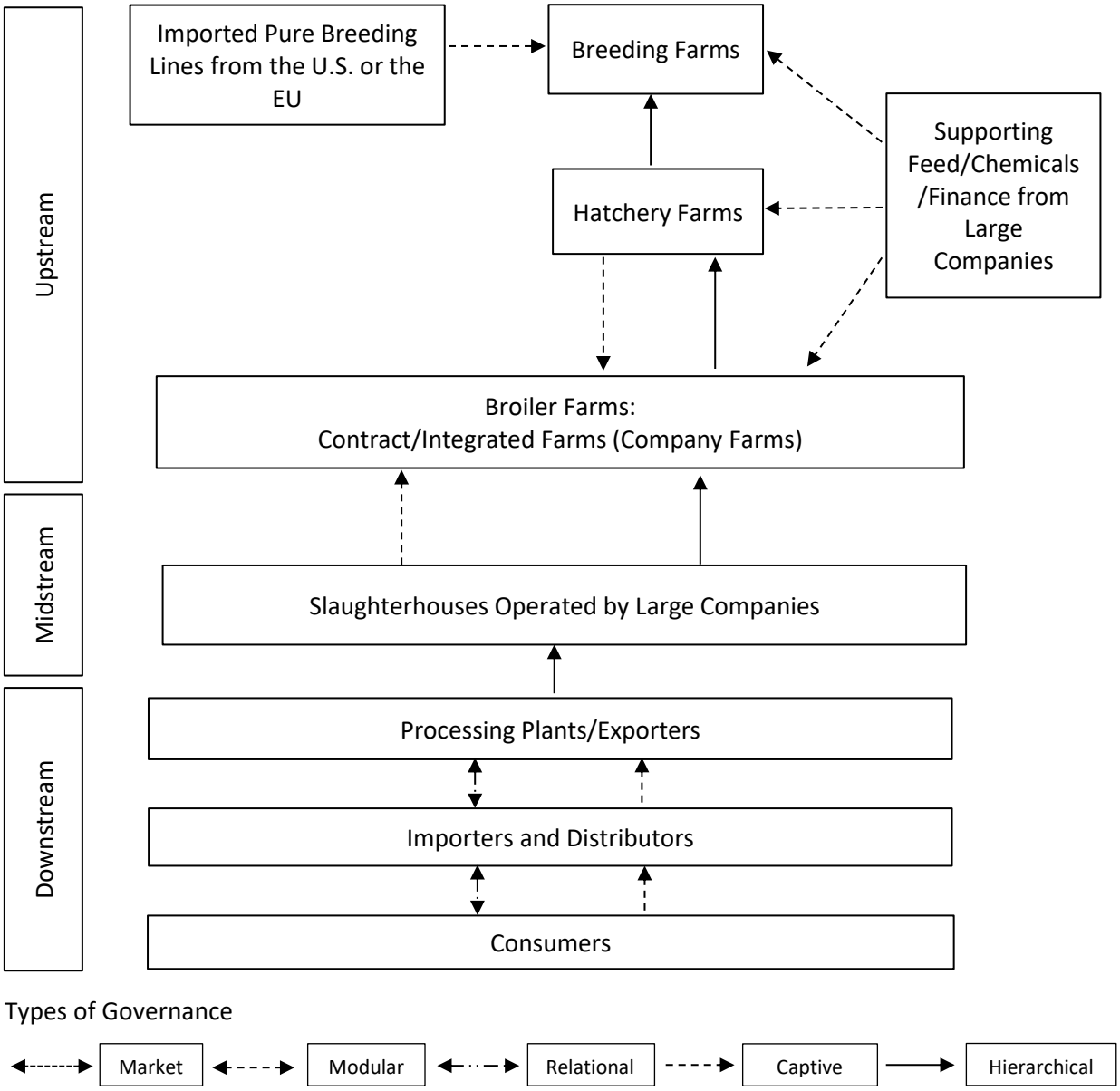


Figure 3-9 The Global Value Chain of Thai Processed Chicken

Source: Summarised by the author

3.3.3 Canned Tuna

The Thai canned tuna industry has been part of GVCs since the 1970s when MNEs' affiliates introduced new business opportunities for local entrepreneurs to produce canned tuna (Kuldilok, 2009). After the establishment of an Australian affiliate, which produced under the "SAFCO" brand in 1973, several local processors later started running their own businesses, e.g., Unicord in 1978, Pattaya Food, and Thai Union Frozen and Tropical canning in 1979 (Kohpaiboon, 2006). Local firms absorbed knowledge and benefits related to canned tuna production from the MNEs' buyer channel. For instance, MNEs helped local entrepreneurs to comply with international food regulations (Kohpaiboon, 2006). As a result, some local companies, such as TUF and the Sea Value groups, have become leading exporters and processors in the tuna GVC (Kuldilok, 2009).

Multi-forms of governance dominate the Thai canned tuna value chain (see Figure 3-10). This is providing raw tuna. Thailand depends heavily on imports of raw tuna because it lacks its own tuna fishing vessels (Kohpaiboon, 2006; Kuldilok, 2009). Ninety per cent of the raw tuna used in the canning industry is imported.[14] Only 10% of the raw tuna used in the industry is captured by Thai vessels (Campling et al., 2007; The Office of Industrial Economics, 2015). Governance at this stage is usually captive. This is because most tuna vessel fleets (foreign fleets) are small and medium enterprises with low capacity. These tuna fleets depend heavily on a few players, such as raw tuna traders (e.g., FCF Fishery, ITOCHU and Tri-Marine) and some Thai processors (primary and secondary processors) (The Asia Foundation and International Labour Organisation, 2015; Hamilton et al., 2011). Raw tuna traders provide knowledge and financial support to tuna vessels that are mostly from Taiwan, South Korea, and Vanuatu (The Asia Foundation and International Labour Organisation, 2015; The Office of Industrial Economics, 2015). The raw tuna traders and some Thai processors guide the tuna vessels so they comply with specific regulations proposed by developed countries regarding environmental issues and human-trafficking (Campling et al., 2007; Hamliton et al., 2011). Raw tuna captured by the fleets is distributed at Thai fish markets (usually located in Samut Sakhon and Songkhla provinces) or by middlemen who have more bargaining power than the fleets.

For the connection between the upstream and midstream, market, captive, and hierarchical governance are more common. The main activity of this stage is the gathering and delivery of raw fish. Normally, raw tuna traders act as significant suppliers to the Thai canned tuna industry. Approximately 70% of the raw tuna used in the industry is supplied by those traders. The rest is supplied by middlemen or auctions from the fish markets, including some independent foreign fleets (Hamilton et al., 2011; The Office of Industrial Economics, 2015). Accordingly, the captive form of governance usually occurs at this stage. Most actors who want tuna to run their business, primary and secondary processors and middlemen, depend on the raw tuna trading companies that have considerable bargaining power at this stage (Hamilton et al., 2011). This is because the actors have a low capacity for gathering raw tuna to respond to their demands. However, some other forms of governance emerge in the midstream processes. For example, the connection between fish markets/middlemen and processers is a form of market coordination. This is because the price of the product (raw tuna traded in the form of whole fish) is a major instrument for negotiation between fish markets/middlemen and processing companies. One of the large companies (TUF) applies a hierarchical form of governance (vertical integration) to control its product quality and supply. TUF has its own tuna fleet.[15] TUF has established its own primary processing plants (located both on- and off-shore). The primary processing plants'

[14] Most species of tuna imported are skipjack, yellowfin and long-finned tuna (The Office of Industrial Economics, 2015).

[15] Some raw fish captured by TUF tuna vessel fleets is counted as a minor proportion compared with their total requirement (Kuldilok, 2009; The Office of Industrial Economics, 2015).

major function is eviscerating the raw tuna and loining. The domestic primary processing plants are usually located near fish markets, such as in Bangkok and surrounding areas, eastern Thailand and some parts of southern Thailand. The overseas plants are usually located in developing countries characterised as labour-intensive countries, such as Vietnam. (Hamilton et al., 2011). This enables them to control their product quality and meet labour and environmental standards (Thai Union Group Public Company Limited, 2016; UNEP, 2009). This is because these issues have become key concerns for developed countries. If canned tuna companies cannot comply and respond to the relevant regulations, they tend to lose their foothold in the world market (Barclay, 2010; Errighi et al., 2016; The Office of Industrial Economics, 2015).

The downstream stage is the most important part of the tuna value chain, since about 75% of the total value creation in the chain emerges at this stage (Hamilton et al., 2011). Normally, secondary processing plants that take responsibility for producing canned tuna are supplied by fish markets/middlemen, primary processing plants and tuna vessel fleets with raw tuna in the form of whole fish and tuna loins. Multiple forms of governance are visible here. The coordination between the fish markets and middlemen can be characterised as a market form. The product price is the primary determinant in deal-making between fish markets and middlemen. The coordination between secondary and primary processing plants is captive governance. This is because most primary processing plants are responsible for some minor parts and jobs (such as cleaning and eviscerating) that do not require much knowledge. Labourers who work at processing plants can absorb the techniques related to cleaning and eviscerating through learning-by-doing (Kohpaiboon, 2006). Thus, most activities occurring in primary processing plants are limited to cleaning and eviscerating and are strictly controlled by the secondary processing plants. In addition, some large processors establish support companies, such as canning, producing and printing companies to support their production (Kuldilok, 2009; Thai Union Group Public Company Limited, 2016). The coordination between large processors and supporting companies represents a hierachical form.

The coordination between secondary processors and importers/distributors is usually captive governance since most canned tuna products produced by those processors are in the form of OEM. Most activities during processing are strictly controlled by the importers/distributors. Sometimes, a form of relational coordination can be seen at this stage. Because of a long history of success in the export of Thai canned tuna, the importers/distributors provide Thai processors/exporters with knowledge about how to comply with the specific requirements of global buyers (Kohpaiboon, 2006). This helps to improve the capabilities of Thai processors. Consequently, there are high levels of trust between them and they have become close trading partners. The hierarchical governance form occurs in the Thai canned tuna value chain. Some large processors acquired global brands and shifted from processors to distributors in developed countries. For example, TUF acquired the global brands Chicken

of the Sea and John West of canned tuna. This increased its distribution channels; TUF is thus an integrated global enterprise in the world tuna industry (Thai Union Group Public Company Limited, 2016). The final stage involves the distributors and consumers. The consumers, who usually live in the developed nations such as the U.S., Japan, and Australia, pay attention to product quality, and other related issues (such as environmental and labour standards) (Hamilton et al., 2011; The Office of Industrial Economics, 2015). To build product loyalty and trusted relationships, distributors need to comply with their requirements. Distributors need to spend significant time to achieve these objectives. This stage therefore usually involves relational and captive governance (Jespersen et al., 2014).

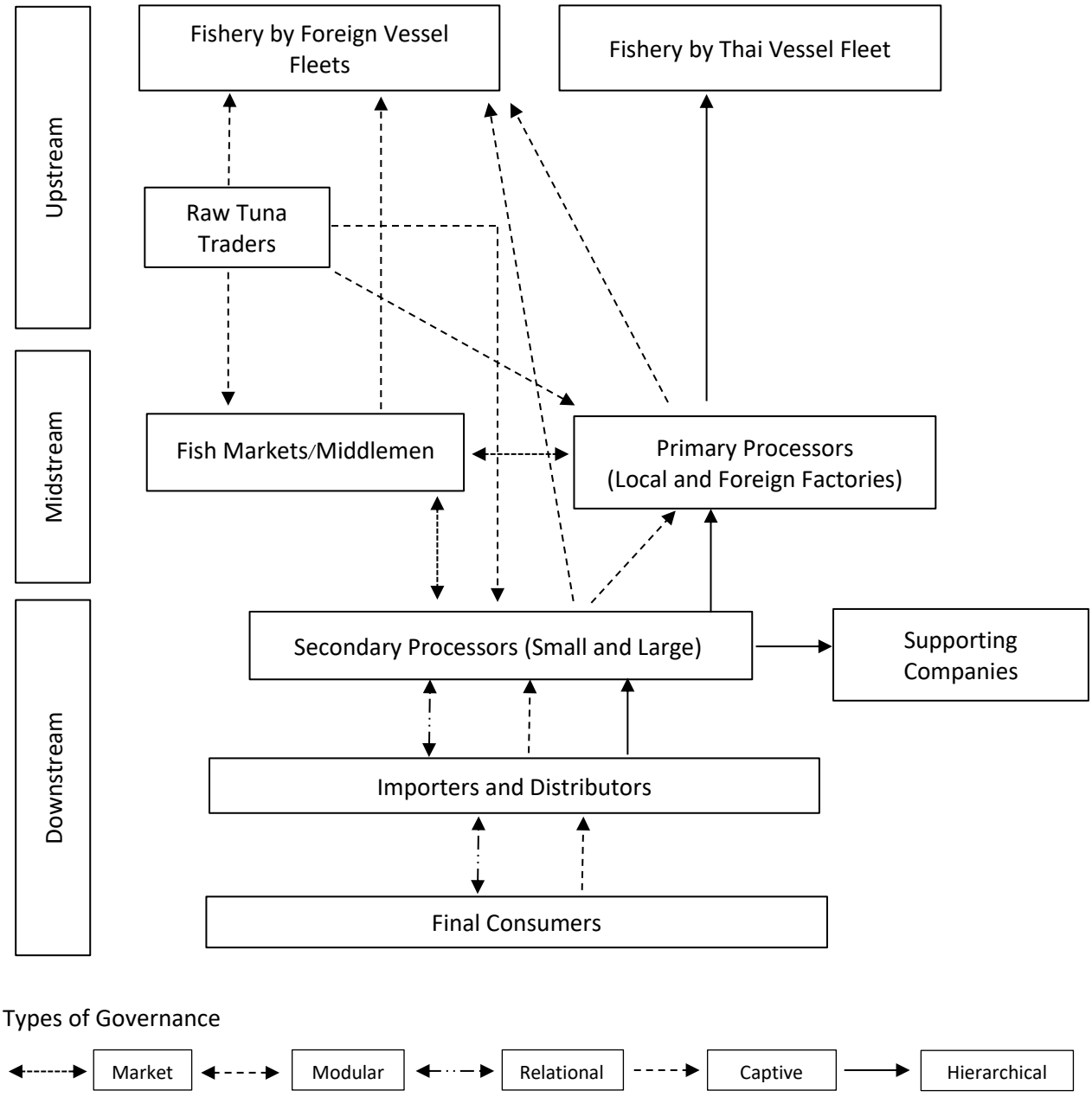


Figure 3-10 The Global Value Chain of Thai Canned Tuna

Source: Summarised by the author

3.3.4 Canned Pineapple

The involvement of the Thai canned pineapple industry in GVCs is somewhat similar to the Thai canned tuna industry. Foreign affiliates introduced business opportunities with these products to local enterprises. In the 1970s, Dole Co. Ltd. (the U.S. affiliate) and Taiwanese investors were among the first to do this (Kohpaiboon, 2006). In the early stages, foreign affiliate companies (such as Dole Co. Ltd.) provided much of the tacit knowledge and helped local enterprises to run their businesses. For instance, foreign affiliates helped local firms to set up automatic peeling and coring machines (named the Ginaca) because those processes cannot be done manually (Kohpaiboon, 2006). This is a significant difference between producing pineapple for direct consumption and for canned products. The differences require different plantation strategies and how to regulate the acidity of the canned pineapple. Pineapples for consumption are usually large, whereas those used for canning are often small. Additionally, controlling the acidity is important in producing canned pineapple. Pineapples grown for canning need to have higher acidity than those grown for direct consumption because this extends the product's shelf life. However, because of the higher acidity of canned pineapple, there is a much higher risk of explosion if incorrect techniques are used (Kohpaiboon, 2006). In addition, the business requires tropical areas for plantations and skilled labourers to sort and grade harvested pineapples. Thailand has an abundance of both of these resources[16] (Kasikorn Research Centre, 2016a; United States International Trade Commission, 2007).

At present, most knowledge and technology on canned pineapple production is widespread in the GVC. Local farmers and processors in Thai's canned pineapple industry can easily access the knowledge and technology from GVCs. Internationally, the canned pineapple traded uses simple forms (sliced, diced, chunks and solid packs) and is often made-to-order (Kohpaiboon, 2006; Wasusri et al., 2007). Moreover, pineapple products do not have to meet many of the food safety standards associated with other processed foods such as processed chicken, shrimp and canned tuna. This is because the production of canned pineapple does not involve transformation from raw to cooked food (Kohpaiboon, 2006; Wasusri et al., 2007). Thus, the governance forms in the Thai canned pineapple chain are different from those in other processed product industries. They are usually captive and hierarchical governance.

From the above discussion, governance forms in Thai canned pineapple value chain can be classified as market and modular relationships. To provide an in-depth analysis, this study separates the canned pineapple value chain into three major stages: upstream, midstream and downstream (see Figure 3-11). In the upstream, only a few parts are related to the pineapple industry: input factors and pineapple

[16] These areas are usually in Prachuap Khiri Khan and the Phetchaburi provinces (Product Marketing Strategy Department, 2015).

plantations (Product Marketing Strategy Department, 2015; Wasusri et al., 2007). The main input factor are pineapple seedlings. The most popular variety for producing canned pineapple is Smooth Cayenne (Food Intelligence Thailand, 2016). Pineapple growers can easily access seedlings since there are specific suppliers who control the supply of seedlings. Pineapple plantations are divided into three main types of farm: individual, contract and company farms. Individual farms are usually small to medium farms. In these farms, pineapple plants are usually planted alongside rubber plants since farmers can receive more income during the early stage of rubber plantation establishment (about 3-4 years). Contract farms are usually larger farms since farmers need to invest a great deal of capital and knowledge to produce a high number of quality pineapples, corresponding to the demands of processing plants. The last type of pineapple plantations are company farms. These farms are vertically operated by large processing plants and are created to provide alternative supplies of fresh pineapple[17] (Food Intelligence Thailand, 2016; Wasusri et al., 2007).

There are many forms of governance in the upstream stage. These depend on the specific characteristics of each pineapple plantation (see Figure 3-11). The relationship between input suppliers and individual growers can be characterised as a market relationship. This is because there is not much knowledge required. Seedling prices play a key role in establishing the connection between them. With contract farms, the captive governance form explains the link between input suppliers and contract farms. This is because large processing plants make agreements related to fresh pineapple production and provide important input factors and technology used to control quality (Wasusri et al., 2007). The last type of farm, company farms, have a hierarchical governance form between input suppliers and the company farms.

The main midstream activity is to distribute fresh pineapple from farms to collectors (see Figure 3-11). Most individual growers sell their output to local collectors who are responsible for primary processing (peeling, cutting and chopping) and selling the products to large processing plants/exporters. Sometimes local collectors are pineapple growers who have large plantations (Wasusri et al., 2007). The price of fresh pineapples depends on the quality, colour, grade and size (The Office of Agricultural Economics, 2017; Wasusri et al., 2007). Some individual farmers sell their products directly to secondary processing plants/exporters. Accordingly, the governance in the relationship between pineapple growers, collectors and processing plants is classified as a market form. In the relationship between contract farms and large processing plants, captive and market relationships cover the economic transactions between them. Large processing plants provide assistance (financial support

[17] In Thailand, a major problems of the pineapple industry is a lack of fresh pineapple to support processing plants. This is because pineapple farms can be easily changed to produce other cash crops when the price of fresh pineapple decreases. There are other significant factors that affect the quantity of fresh pineapple, particularly those related to climate change (The Office of Agricultural Economics, 2017; Wasusri et al., 2007).

and seedlings) and control the production processes of contract farms to control fresh pineapples' quality. This is captive governance. However, pineapple growers are not obliged to sell their output to processing plants even though they may gain assistance from them. Occasionally, pineapple growers or processors break a contract when fresh pineapple prices do not correspond with their expectations (United States International Trade Commission, 2007; Wasusri et al., 2007). This situation is an example of the market governance. In the downstream, some large processing plants (secondary processors/exporters) have their own canning factories. Others, by contrast, have to buy cans from other firms. These examples are evidence of hierarchical and market governance, respectively (Wasusri et al., 2007). The relationship between processing plants and importers can be presented in various forms. The governance type is between Thai processors and importers who mainly depend on the ability of the processors. Some large processors, Dole Thailand and the Thai pineapple canning industry, which have high capability and much experience are under the direct importer control (modular governance). In contrast, small processors with low capability are controlled by the captive governance form. In some cases, the relationship between Thai processors and importers/distributors can be described as market governance. In particular, canned pineapple products are simple and easily substituted by the same product from other countries, such as the Philippines and Indonesia (Kasikorn Research Centre, 2016a; Kohpaiboon, 2006; Wasusri, 2007). Product price is the connection between Thai processors and importers. Figure 3-11 demonstrates the relationship between canned pineapple importers/distributors and final consumers (usually Europeans and Japanese). Some large MNEs with high capability can provide canned pineapple products corresponding to each market's demand. This situation illustrates modular governance. The market relationship can be used to explain the connection between distributors and consumers. This is because product requirements are simple. Consequently, demand is usually determined by product price (Kohpaiboon, 2006).

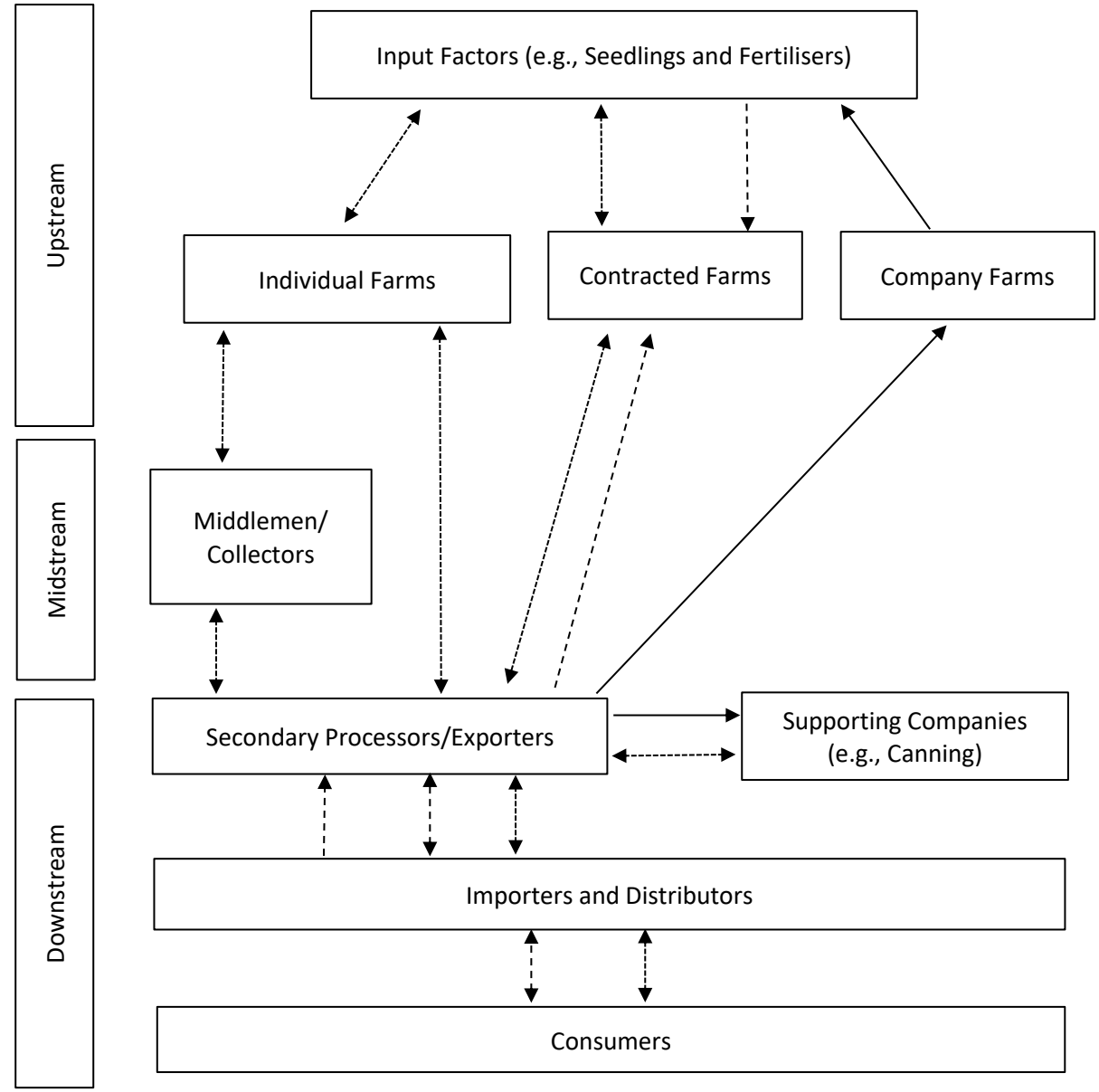


Figure 3-11 The Global Value Chain of Thai Canned Pineapple

Source: Summarised by the author

3.4 An Analysis of the Export Competitiveness of Thai Processed Food

This section analyses the export competitiveness of TPFS in global markets from 1998 to 2016. Four specific processed food products are used as a case study: processed shrimp, processed chicken, canned tuna and canned pineapple. These products were chosen because they are major export products from the processed food industry. The first section reviews measurements of export competitiveness. The second section provides an overview of the data source and empirical results.

3.4.1 Measurements of Export Competitiveness

Measurements of export competitiveness are used to compare key exporters to determine which plays a key role in the world market. Scholars use various mechanisms to analyse export competitiveness. Popular methods include Revealed Comparative Advantage (RCA) indices, market share and export price analysis (Alon et al., 2010; Bojnec & Ferto, 2018; Esterhuizen & Van Rooyen, 2006; Utkulu & Seyman, 2004). RCA indices are key instruments used to determine the export competitiveness of countries over several decades (Davar & Singh, 2013; Esmaeili, 2014; Leromain & Orefice, 2013; Narayan& Bhattachaya, 2019; Seyoum, 2007). The most well known RCA index was introduced by Balassa (1965) and is called the Balassa Index (BI). The range its value is between zero and positive infinity. If the value is greater than unity, it implies that the country has a comparative advantage, otherwise it has a comparative disadvantage (0,1) (Balassa, 1965). The index is illustrated as follows:

$$\mathrm{RCA}_{\mathrm{i,c,t}} = \mathrm{BI}_{\mathrm{i,c,t}} = \left(\frac{\mathrm{X}_{\mathrm{i,c,t}}}{\sum_{\mathrm{c}} \mathrm{X}_{\mathrm{i,c,t}}}\right) / \left(\frac{\sum_{\mathrm{i}} \mathrm{X}_{\mathrm{i,c,t}}}{\sum_{\mathrm{c}} \sum_{\mathrm{i}} \mathrm{X}_{\mathrm{i,c,t}}}\right) \quad (3.1)$$

where: t refers to given time; $\mathrm{X}_{\mathrm{i,c,t}}$ represents exporting product i of country c; $\sum_{\mathrm{c}} \mathrm{X}_{\mathrm{i,c,t}}$ refers to exporting product i by all countries; $\sum_{\mathrm{i}} \mathrm{X}_{\mathrm{i,c,t}}$ denotes total exporting products of country c; and $\sum_{\mathrm{c}} \sum_{\mathrm{i}} \mathrm{X}_{\mathrm{i,c,t}}$ is the world's total exports.

According to several scholars, there are problems using the BI index (Gnidchenko & Salnikov, 2015; Hoen & Oosterhaven, 2006; Yu et al., 2009). For example, the index is asymmetric because the lower and upper bounds of the BI values are unbalanced. The lower bound, which represents comparative disadvantage, has fixed values (0,1). The upper bound, in contrast, referring to the comparative advantage, has no limit (>1). No limit to the upper bound can lead to extremely high BI scores, which often occurs with small countries. For example, if country A has few export products, then country A has a high BI score for a given product. In contrast, if country B has many export products with large total export volumes, then it will have a lower BI score for a given product. As a result, the BI score for country A tends to be higher than the BI score for country B even though country A plays a minor role in the world market. This leads to misleading, biased results when comparing two countries that have different levels of development and participation in the world trade system (Benedictis & Tamberi, 2001; Gnidchenko & Salnikov, 2015; Yeats, 1985; Yu et al., 2009). Another problem associated with the BI index is that it does not account for import data. Some empirical studies acknowledge that net exports are an appropriate indicator of comparative advantage in the world market. However, focusing solely on exports neglects the possibility that a country may import a substantial number of products that they also export. This is because a country with a strong position in the export market of a given product may be associated with international value-added chains (e.g., a country may re-export the product with minor changes), that is particularly common in modern trade (Gnidchenko & Salnikov,

2015). Thus, an indicator constructed with net exports tends to provide a more complete picture of a given country's comparative advantage (De Ferranti, et al., 2002; Gnidchenko & Salnikov, 2015).

Some scholars use alternative measurements to determine a country's comparative advantage (see Table 3-8). For the asymmetric nature of the BI, there are various methods to address it. For example, Laursen (1998) uses the BI to create a new index that has a range from -1 to 1, with 0 as the demarcation point. An index value between 0 and 1 denotes a comparative advantage. If the index scores are between -1 and 0 then the country has a comparative disadvantage. Hoen and Oosterhaven (2006) apply the BI model to construct their index. It has the same range of index values as Laursen's (1998) index. They note that if the index is between 0 and 1, the particular country has a comparative advantage. Yu et al. (2009) constructed a normalised revealed comparative advantage (NRCA) index to solve the BI problem. The upper and lower limits of this index are different from Laursen (1998) and Hoen and Oosterhaven's (2006) indices. Yu et al.'s (2009) index is between -0.25 and 0.25, which means that if the index score is -0.25 to 0, the country has a comparative disadvantage. On the hand, if the index value is between 0 and 0.25, it signifies a country's comparative advantage.

Previous studies have used net exports to construct different formulas to evaluate comparative advantage. For example, UNIDO (1982) argues that the RCA index could be calculated using the net exports of a given product divided by the sum of exports and imports of such a product. The range of the index is -1 to 1, with a demarcation point of zero. If the index value is 1 (-1), it implies that a country has a comparative advantage (disadvantage). Vollrath (1991) introduced the modified RCA index using the concept of net exports. The index value outlines the difference between the Relative Export Advantage Index (RXA) and the Relative Import Penetration Index (RMP). The index score can be greater or less than zero. If the former dominates, it implies that a country has a comparative advantage. On the other hand, a comparative disadvantage will emerge if the latter case dominates. Gnidchenko and Salnikov (2015) construct a formula to account for comparative advantage using multiplication between Relative Net Export (RNX), Relative Trade Intensity (RT) and Relative Openness of the Economy (RO) (see Table 3-8). The authors maintain that the openness of an economy should be considered as one of the main factors in the computation of the RCA index. This is because if a country's turnover is unnecessary relative to its GDP, applying the BI model to illustrate the comparative index of such a country can lead to misleading interpretations about the importance of trade flows for the economy. The comparative advantage index score introduced by Gnidchenko and Salnikov (2015) is $(-\infty,\infty)$. A positive (negative) value refers to a comparative advantage (disadvantage).

Although the main purpose of each methods is to overcome the drawbacks of the BI model, controversy over the advantages and disadvantages of the methods remains. For example, Gnidchenko

and Salnikov (2015) state that the formulas that have a symmetric index have only one advantage, the presence of precise upper and lower bounds. However, the problem of the asymmetric index can be eliminated by taking a logarithm or normalising the BI. Focusing on formulas related to the net export framework, may generate misleading results/interpretations. For example, a country with tiny exports or absent imports will have a high score or be seen to have a comparative advantage (Gnidchenko & Salnikov, 2015).

However, debate about specific advantages and disadvantages of RCA indices is still in its early stages. There is no evidence to indicate which is the best method to estimate comparative advantage. Empirical research uses various methods to provide robust results (Khai et al., 2016; Tripa et al., 2016). Consequently, BI and all alternative formulas of RCA indices in Table 3-8 , including the analysis of market share and export prices, are used to compare export competitiveness in the specific export products (processed shrimp, processed chicken, canned tuna and canned pineapple) between Thailand and the other key exporters in the world market.

Table 3-8 **Alternative RCA Indices**

Indices	Formulas	Criteria	
		Comparative Disadvantage	Comparative Advantage
UNIDO (1982)	$RCA^{U}_{i,c,t} = \frac{X_{i,c,t} - M_{i,c,t}}{X_{i,c,t} + M_{i,c,t}}$	(-1,0)	(0,1)
Vollrath (1991)	$RCA^{V}_{i,c,t} = RXA_{i,c,t} - RMA_{i,c,t}$ $RXA_{i,c,t} = \left(\frac{X_{i,c,t}}{\sum_i X_{i,c,t} - X_{i,c,t}}\right) / \left(\frac{\sum_c X_{i,c,t} - X_{i,c,t}}{\sum_i \sum_c X_{i,c,t} - \sum_i X_{i,c,t} - \sum_c X_{i,c,t}}\right)$ $RMA_{i,c,t} = \left(\frac{M_{i,c,t}}{\sum_i M_{i,c,t} - M_{i,c,t}}\right) / \left(\frac{\sum_c M_{i,c,t} - M_{i,c,t}}{\sum_i \sum_c M_{i,c,t} - \sum_i M_{i,c,t} - \sum_c M_{i,c,t}}\right)$	(-∞,0)	(0,∞)
Laursen (1998)	$RCA^{L}_{i,c,t} = \frac{BI_{i,c,t} - 1}{BI_{i,c,t} + 1}$	(-1,0)	(0,1)
Hoen and Oosterhaven (2006)	$RCA^{HO}_{i,c,t} = \frac{X_{i,c,t}}{\sum_i X_{i,c,t}} - \frac{\sum_c X_{i,c,t}}{\sum_c \sum_i X_{i,c,t}}$	(-1,0)	(0,1)
Yu, Cai and Leung (2009)	$RCA^{YCL}_{i,c,t} = \left(\frac{X_{i,c,t}}{\sum_i \sum_c X_{i,c,t}}\right) - \left(\frac{\sum_c X_{i,c,t} \times \sum_i X_{i,c,t}}{\sum_i \sum_c X_{i,c,t} * \sum_i \sum_c X_{i,c,t}}\right)$	(-0.25,0)	(0,0.25)
Gnidchenko and Salnikov (2015)	$RCA^{GS}_{i,c,t} = RNX_{i,c,t} \times RT_{i,c,t} \times RO_{i,c,t}$ $RNX_{i,c,t} = \frac{X_{i,c,t} - M_{i,c,t}}{X_{i,c,t} + M_{i,c,t}}$ $RT_{i,c,t} = \left(\frac{X_{i,c,t} + M_{i,c,t}}{\sum_i X_{i,c,t} + \sum_i M_{i,c,t}}\right) / \left(\frac{\sum_c X_{i,c,t} + \sum_c M_{i,c,t}}{\sum_i \sum_c X_{i,c,t} + \sum_i \sum_c M_{i,c,t}}\right)$ $RO_{i,c,t} = \left(\frac{\sum_i X_{i,c,t} + \sum_i M_{i,c,t}}{GDP_{c,t}}\right) / \left(\frac{\sum_i \sum_c X_{i,c,t} + \sum_i \sum_c M_{i,c,t}}{\sum_c GDP_{c,t}}\right)$	(-∞,0)	(0,∞)

Note: X and M refer to exports and imports. i, c and t refer to product i, country c and time t, respectively.
Source: Author's summarisation

3.4.2 The Export Competitiveness of Thai Processed Food: A Comparison with Competitors

3.4.2.1 Data Sources

To determine the competitors of Thai products in the global market, this study uses market share percentages. Competitors of Thai processed shrimp exports are Vietnam, India, China, and Indonesia. The competitors of Thai processed chicken exports are China, the Netherlands, Germany, and Brazil. For canned tuna, Ecuador, Spain, Indonesia and the Philippines are the important competitors. The key rivals of Thai canned pineapple are the Philippines, Indonesia, Kenya, and the Netherlands (see Tables 3-9 and 3-10). To analyse the export competitiveness of the key exporters, we need export and import values of the given products and GDPs for 1998 to 2016. The export and import values for each product, for both Thailand and competitors, were extracted from the UN Comtrade database. GDP figures were extracted from the World Development Indicators.

3.4.2.2 Export Competitivness Analysis by using Market Share and Export Price

Vietnam, India, China, and Indonesia were the competitors of Thai processed shrimp exports during 1998-2016 (see Tables 3-9 and 3-10). Thai processed shrimp export share has significantly decreased from 27.68% during 1998-2000 to 9.46% during 2013-2016 (see Table 3-9). In contrast, Vietnam, India, and China have increased their processed shrimp exports over the past two decades. Vietnam's export share increased from 6.42% during 1998-2000 to 15.21% during 2013-2016. India's export share increased from 9.09% to 16.41% at the same time and China's export share reached 10.73% during 2013-2016 from 3.19% previously. Indonesia's export share of processed shrimp changed only slightly from 1998 to 2016, averaging 8-10%. Table 3-10 shows that Thai processed shrimp export prices were relatively higher than for the other exporters. The Thai processed shrimp export price averaged 8,600 U.S. dollars per tonne during 1998-2016. By contrast, the processed shrimp export prices for Vietnam, India and China were less than 7,000 U.S. dollars per tonne over the same period.

As discussed above, Thailand has been facing the loss of export competitiveness in the processed shrimp market. This is reflected in a reduced export share and relatively high export prices for processed shrimp. As discussed in Section 3.2, the key factors that have contributed to the loss are the outbreak of EMS and loss of GSP. In addition, wages in Thailand are higher than for competitors. This leads to a shift in production costs (Kasikorn Research Centre, 2016a; The Office of Industrial Economics, 2015).

China, the Netherlands, Germany and Brazil were the key competitors for Thai processed chicken exports during 1998 to 2016 (see Tables 3-9 and 3-10). Interestingly, the Thai processed chicken export share has noticeably increased, shifting from 18.14% during 1998-2000 to 29.24% during 2013-2016 (see Table 3-9). In contrast, China's and the Netherlands' export shares were down.

Table 3-9 A comparison of market shares of processed food exporters from 1998 to 2016

Products	Period					
	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
Processed shrimp	%	%	%	%	%	%
Thailand	27.68	19.91	16.21	19.30	27.89	9.46
Vietnam	6.42	8.11	10.60	11.98	18.88	15.21
India	9.09	9.12	8.28	6.71	12.44	16.41
China	3.19	6.56	9.77	10.16	16.76	10.73
Indonesia	9.71	8.76	8.29	7.40	10.05	8.40
Processed chicken	%	%	%	%	%	%
Thailand	18.14	17.16	22.63	26.72	28.97	29.24
China	17.98	22.76	20.64	13.34	16.44	15.26
Netherlands	17.67	14.54	11.00	11.27	8.10	6.60
Germany	5.82	6.01	8.21	9.77	10.09	9.49
Brazil	1.76	3.42	6.51	9.76	7.97	6.49
Canned tuna	%	%	%	%	%	%
Thailand	40.09	40.86	42.41	41.68	43.35	37.65
Ecuador	6.87	10.55	10.28	9.70	10.89	14.73
Spain	11.68	12.87	11.28	10.37	10.54	9.16
Indonesia	6.01	5.12	4.81	4.20	5.20	5.33
Philippines	5.97	5.16	3.43	5.31	4.74	5.47
Canned pineapple	%	%	%	%	%	%
Thailand	42.28	41.00	43.29	47.86	49.51	45.22
Philippines	14.87	14.45	13.12	12.93	15.96	21.68
Indonesia	10.31	12.12	12.10	11.24	12.83	13.49
Kenya	7.11	8.17	5.78	5.69	4.31	5.45
Netherlands	4.84	3.78	3.80	4.41	3.90	3.37

Source: Author's computation

The Chinese export share processed chicken decreased from 17.98% to 15.26% during the latter period. The Dutch export share of this product dropped from 17.67% during 1998-2000 to 6.60% during 2013-2016. German and Brazilian export shares of processed chicken have shown an upward trend, but they are minimal compared with the Thai increase. The overall trend in export prices for the key exporters is upward (see Table 3-10).

Table 3-10 A comparison of the export prices of processed food exporters from 1998 to 2016

Unit: U.S. dollars/tonne

Products	Period					
Processed shrimp	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
Thailand	10,234.01	8,198.88	6,679.65	7,084.50	8,635.38	10,818.88
Vietnam	6,978.40	6,274.85	6,163.67	6,676.21	6,570.43	9,275.79
India	6,339.43	5,446.05	5,065.14	5,895.33	6,332.34	9,684.01
China	4,556.78	5,118.48	5,262.73	5,702.11	7,556.84	10,633.45
Indonesia	8,300.12	7,343.22	6,649.80	6,955.82	8,241.58	9,954.75
Processed chicken	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
Thailand	3,195.87	2,950.67	2,962.43	3,908.12	4,325.59	4,532.24
China	2,952.84	2,976.50	3,149.86	3,581.17	4,199.36	4,298.65
Netherlands	3,794.97	3,250.03	3,879.15	4,370.44	4,450.24	4,476.92
Germany	3,537.18	3,397.86	3,811.05	4,749.51	4,641.08	4,414.59
Brazil	2,953.97	2,405.71	2,212.10	2,860.04	2,837.80	2,713.87
Canned tuna	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
Thailand	2,305.79	2,141.68	2,392.89	3,397.97	3,964.17	3,933.28
Ecuador	2,378.14	2,244.42	2,578.23	3,850.78	4,605.22	4,779.73
Spain	3,447.17	3,501.46	4,299.82	5,609.96	6,001.49	5,954.48
Indonesia	2,282.20	2,264.98	2,580.12	3,354.96	4,085.95	4,377.32
Philippines	1,751.55	1,626.45	1,802.28	2,514.04	2,867.06	3,059.69
Canned pineapple	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
Thailand	640.45	555.84	626.48	859.63	950.42	1,047.10
Philippines	370.02	356.45	417.98	585.11	770.02	909.09
Indonesia	587.64	516.57	540.64	728.83	916.68	1,047.96
Kenya	636.74	605.92	715.59	793.53	1,139.48	1,186.22
Netherlands	808.21	801.51	836.53	1,350.44	1,619.56	1,695.49

Source: Author's computation

However, the export prices for developing countries (e.g., Thailand, China and Brazil) have been lower than those for developed countries (the Netherlands and Germany). The average price of Thai and Chinese processed chicken exports were 3,500-3,600 U.S. dollars per tonne during 1998-2016. The average export price for Brazilian processed chicken was about 2,600 U.S. dollars per tonne during the same period. In contrast, the averaged export prices for the Netherlands and Germany were greater than 4,000 U.S. dollars per tonne during that period.

From the discussion of market share and export price of processed chicken, Thailand still achieved high export competitiveness in processed chicken. The key factor contributing to its success is effectively eliminating and preventing the outbreak of bird flu (Krungsri Research, 2016). In contrast, China and

EU countries have recently faced an outbreak of bird flu (Kasikorn Research Centre, 2016b). This enabled Thai processed chicken export expansion. In addition, Thailand has gained some trade privileges from a trade agreement with Japan (JTEPA), which is a key trading partner for Thai processed chicken (Kasikorn Research Centre, 2016a). Interestingly, although Brazil had the lowest export price among key exporters, the Brazilian export share was still lower than the shares of other exporters. This is because there is a huge domestic consumption of chicken in Brazil (Krungsri Research, 2017).

Thailand has captured a large export share of canned tuna over the past two decades. Thai canned tuna's export share of the global market was about 40% during 1998-2016. Ecuador, Spain, Indonesia and the Philippines, which had been key competitors, had export shares of less than 15% over the same period (see Table 3-9). The key exporters' prices have seen an upward trend because of a lack of raw tuna supply in the world market (Hamilton et al., 2011). Interestingly, Thailand, which had the largest market share of the global trade, had the lowest price for canned tuna compared with the other key exporters (except for the Philippines), even though Thailand could not provide raw tuna from domestic fisheries (Campling et al., 2007). The Thai canned tuna export price was 3,000 U.S. dollars per tonne, on average, during 1998-2016 (see Table 3-10). Ecuador, Spain and Indonesia's export prices were 3,400, 4,800 and 3,200 U.S. dollars per tonne, respectively, on average, during the same period.

Thailand has achieved success as the largest exporter of canned tuna in the world market. A key factor contributing to Thailand's canned tuna success is the economy of scale. This situation led to a reduced export price even though Thailand needs to import raw tuna. Moreover, some Thai enterprises operating in the canned tuna industry have their own global brands, such as TUF (Kohpaiboon, 2006; Kuldilok, 2009; Thai Union Group Public Company Limited, 2016). This supports expansion of the distribution channels in developed countries that are the main destinations for canned tuna. Therefore, Thailand has had a higher level of export competitiveness than other exporters in the global canned tuna industry.

Thailand, the Philippines, Indonesia, Kenya and the Netherlands have been key exporters of canned pineapple during 1998-2016 (see Tables 3-9 and 3-10). There have been no important changes in the ranking of exporters. Thailand has remained the largest exporter of canned pineapple over the study period, followed by the Philippines, Indonesia, Kenya and the Netherlands (see Table 3-9). However, among the exporters listed in Table 3-10, the Philippines exhibited a noticeable increase in export share. Its export share increased from 14.87% during 1998-2000 to 21.68% during 2013-2016. Although a noticeable increase in the Philippines export share occurred, its share was still significantly lower than Thailand's share.

The export price of Thai canned pineapple was 780 U.S. dollars per tonne, on average, during 1998-2016. This price was higher than the export prices for the Philippines and Indonesia. The export prices

of canned pineapple from the Philippines and Indonesia were 568 and 723 U.S. dollars per tonne, respectively, during the same period. The other key exporters, Kenya and the Netherlands, have had higher export prices with lower export shares than Thailand (see Table 3-10).

Based on the market share and export price of traded canned pineapple, Thailand still maintained its export competitiveness, despite the fact that they have less land for cultivating the fruit. This is because Thailand has efficient facilities supporting the canned pineapple industry (Kohpaiboon, 2006). However, Thailand has been facing challenges due to increasing export prices for canned pineapple. In particular, Thailand's price is higher than the Philippines' price. This factor is important for maintaining export competitiveness in traded canned pineapple. As discussed in Section 3.3, canned pineapple is sold in simple forms. Thus, price competitiveness contributes to success in the global markets (Kasikorn Research Centre, 2016a; Kohpaiboon, 2006).

3.4.2.3 Export Competitivness Analysis by RCA Indices

Another method used to analyse the export competitiveness of key exporters is the RCA index. From the literature review, various RCA indices have been used to obtain robust results. This study adjusts the RCA^{L} and RCA^{HO} indices by multiplying them by 10,000 for easier reading. This does not affect the overall results (Yu et al., 2009). This is because the original RCA^{L} and RCA^{HO} calculations are usually tiny values (many decimal places). It is difficult to report these in results tables.

Table 3-11 shows that Thailand has been facing decreased export competitiveness in traded processed shrimp since 1998. This is reflected in reduced RCA values for Thailand's processed shrimp exports. For example, the BI value decreased from 29.58 over 1998-2000 to 7.39 over 2013-2016. The RCA^{GLS} value dropped from 25.61 to 8.66 during the same period. The same change is seen in RCA^{V} and RCA^{HO}. These results are similar to those for export competitiveness analysis using market share and the export price; Vietnam overtook Thailand in terms of competitiveness. Most RCA indices for Vietnam are higher than for Thailand (see Table 3-11). However, Vietnam also faced a loss in processed shrimp export competitiveness. This is reflected in reduced BI, RCA^{U}, RCA^{V} and RCA^{Ho} values. India's, China's and Indonesia's export competitiveness in processed shrimp also decreased over 1998-2016. Chinese and Indonesian export competitivenesses were significantly less than Thailand's and the Vietnam's export competitivenesses (see Table 3-11).

Table 3-11 The RCA Indices of the Key Exporters of Processed Shrimp

Exporters	Period					
Thailand	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	29.58	18.58	14.19	15.39	14.87	7.39
RCA^{U}	0.90	0.85	0.92	0.95	0.97	0.90
RCA^{V}	39.40	22.09	16.29	18.54	18.10	7.74
RCA^{L}	0.93	0.89	0.87	0.88	0.87	0.76
RCA^{HO}	383.34	250.29	153.35	144.90	142.28	75.16
RCA^{YCL}	3.29	2.51	1.67	1.74	1.80	0.96
RCA^{GLS}	25.61	17.82	14.62	17.75	18.10	8.66
Vietnam	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	27.48	30.70	31.95	28.22	23.44	18.48
RCA^{U}	0.94	0.91	0.91	0.94	0.91	0.80
RCA^{V}	29.70	33.59	35.55	31.95	26.33	20.03
RCA^{L}	0.93	0.94	0.94	0.93	0.92	0.89
RCA^{HO}	419.82	424.98	360.42	272.54	230.88	207.04
RCA^{YCL}	0.89	1.06	1.14	1.11	1.25	1.71
RCA^{GLS}	22.16	25.87	31.82	33.59	34.01	35.28
India	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	15.57	11.80	8.34	5.32	5.30	9.58
RCA^{U}	1.00	0.99	0.99	0.99	0.99	0.99
RCA^{V}	17.21	12.99	9.02	5.62	5.72	11.44
RCA^{L}	0.88	0.84	0.78	0.68	0.68	0.81
RCA^{HO}	195.83	154.35	85.59	43.06	43.83	102.35
RCA^{YCL}	1.05	1.12	0.81	0.52	0.70	1.75
RCA^{GLS}	2.43	2.38	1.99	1.42	1.64	2.77
China	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	0.95	1.24	1.26	1.04	1.05	0.82
RCA^{U}	0.59	0.68	0.77	0.82	0.80	0.60
RCA^{V}	0.74	1.04	1.12	0.92	0.94	0.56
RCA^{L}	-0.03	0.11	0.11	0.02	0.03	-0.10
RCA^{HO}	-0.58	3.50	3.07	0.37	0.53	-2.17
RCA^{YCL}	-0.01	0.18	0.22	0.03	0.06	-0.30
RCA^{GLS}	0.23	0.46	0.64	0.54	0.53	0.36
Indonesia	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	11.80	9.87	9.52	7.95	6.29	8.80
RCA^{U}	0.98	0.98	0.96	0.99	0.98	0.98
RCA^{V}	12.89	10.62	10.03	8.49	6.63	9.54
RCA^{L}	0.84	0.81	0.81	0.78	0.73	0.80
RCA^{HO}	144.47	126.61	99.13	69.42	54.04	92.84
RCA^{YCL}	1.09	1.05	0.82	0.62	0.58	0.88
RCA^{GLS}	4.47	4.09	3.80	3.25	2.87	3.26

Source: Author's computation

Thailand and China had greater export competitiveness of processed chicken than the other key exporters during 1998-2016 (see Table 3-12). Most of Thailand's RCA values indicate that Thailand's export competitiveness of processed chicken has noticeably improved. For example, Thailand's RCA^{HO} and RCA^{GLS} indices increased from 27.59 and 17.96 to 85.76 and 27.69, respectively (see Table 3-12). China, in contrast, has had a reduction in processed chicken export competitiveness in the world

market. This is reflected in several decreased RCA values. For instance, RCA^{V} dropped from 6.71 during 1998-2000 to 1.17 during 2013-2016; the RCA^{GLS} value decreased from 1.89 to 0.66 during the same period (see Table 3-12). This was because of the outbreak of bird flu in China (Kasikorn Research Centre, 2016b; Krungsri Research, 2017). The Netherlands' export competitiveness of processed chicken has continuously decreased. All of the Netherland's RCA indices have decreasd (see Table 3-12). The country has been disadvantaged by an outbreak of bird flu (Kasikorn Research Centre, 2016b; Krungsri Research, 2017). This is seen in negative values of RCA^{U}, RCA^{V} and RCA^{GLS} during 2013-2016. Table 3-12 demonstrates that Germany has had a comparative disadvantage over the past two decades in processed chicken exports. This is seen in RCA^{U}, RCA^{V} and RCA^{GLS} being negative. Although Germany saw an upward trend in export share during 1998-2016, the situation implies a phenomenon of re-export that emerges for developed countries. Those countries import processed food as made-to-order products from developing countries, then relabel the products using their own brands (Heft-Neal et al., 2008; Kohpaiboon, 2006). Brazil's export competitiveness (in terms of processed chicken) has improved; this is evident in a shift in most RCA values during 1998-2016. For instance, the RCA^{U} value for Brazil increased from 2.38 during 1998-2000 to 5.49 during 2013-2016 (see Table 3-12). This is because Brazil gained an advantage through the outbreak of bird flu in other exporting countries (Krungsri Research, 2017). However, the export competitiveness of Brazilian processed chicken was less than that of Thai processed chicken.

Table 3-12 The RCA Indices of the Key Exporters of Processed Chicken

Exporters	Period					
Thailand	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	16.89	17.37	21.37	23.62	23.19	22.45
RCA^{U}	1.00	1.00	1.00	1.00	1.00	1.00
RCA^{V}	20.01	20.96	27.67	32.83	32.65	31.45
RCA^{L}	0.89	0.89	0.91	0.92	0.92	0.91
RCA^{HO}	27.59	41.55	55.32	75.79	81.00	85.76
RCA^{YCL}	0.26	0.43	0.60	0.90	1.02	1.11
RCA^{GLS}	17.96	19.28	23.43	28.59	28.19	27.69
China	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	5.70	5.02	2.86	1.55	1.52	1.15
RCA^{U}	1.00	1.00	1.00	1.00	1.00	1.00
RCA^{V}	6.71	6.28	3.36	1.66	1.63	1.17
RCA^{L}	0.70	0.66	0.48	0.20	0.21	0.06
RCA^{HO}	7.07	9.98	5.05	1.76	1.92	0.56
RCA^{YCL}	0.22	0.48	0.37	0.16	0.21	0.07
RCA^{GLS}	1.89	2.34	1.69	0.93	0.84	0.66
Netherlands	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	5.76	4.12	2.90	2.92	2.21	1.78
RCA^{U}	0.35	0.32	0.25	0.21	-0.02	-0.11
RCA^{V}	4.59	2.23	1.15	0.83	-0.37	-0.87
RCA^{L}	0.69	0.61	0.48	0.49	0.38	0.28
RCA^{HO}	6.70	7.86	5.13	6.39	4.41	3.09
RCA^{YCL}	0.21	0.29	0.20	0.26	0.16	0.11
RCA^{GLS}	3.01	2.51	1.68	1.57	-0.11	-0.72
Germany	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	0.78	0.67	0.88	1.11	1.25	1.14
RCA^{U}	-0.41	-0.24	-0.13	0.02	-0.01	0.11
RCA^{V}	-0.87	-0.72	-0.63	-0.31	-0.31	-0.02
RCA^{L}	-0.14	-0.20	-0.07	0.05	0.11	0.06
RCA^{HO}	-0.41	-0.85	-0.33	0.36	0.93	0.54
RCA^{YCL}	-0.03	-0.08	-0.03	0.03	0.07	0.04
RCA^{GLS}	-0.64	-0.33	-0.23	0.03	-0.03	0.18
Brazil	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	2.36	3.76	5.69	8.37	5.91	5.19
RCA^{U}	1.00	1.00	1.00	1.00	1.00	1.00
RCA^{V}	2.38	3.86	6.05	9.25	6.36	5.49
RCA^{L}	0.40	0.58	0.69	0.79	0.71	0.68
RCA^{HO}	1.99	7.12	12.78	24.61	17.87	16.77
RCA^{YCL}	0.01	0.07	0.15	0.30	0.25	0.21
RCA^{GLS}	0.26	0.57	1.05	1.65	1.20	1.02

Source: Author's computation

Thailand and Ecuador have a greater export comparative advantage in the canned tuna industry than other key exporters (Spain, Indonesia and the Philippines) over 1998-2016 (see Table 3-13). However, Thailand has been facing a decrease in its export competitiveness; most Thai canned tuna RCA indices have dropped. For instance, the RCA^{V} value for Thailand reduced from from 68.6 during 1998-2000 to 40.85 during 2013-2016 (see Table 3-13). As discussed above, this is because of the IUU problem and

a lack of raw tuna (Campling et al., 2007; The Office of Industrial Economics, 2015). In contrast, Ecuador's export competitiveness in canned tuna has noticeably improved as is seen in an increase in most RCA values for Ecuador's canned tuna. For instance, the RCA^{GLS} value increased from 27.87 to 56.55 during the period (see Table 3-13). The privilege of tariff preferences (from the U.S. and the EU) contributed to Ecuador's export competitiveness in canned tuna exports (Campling et al., 2007). Spain's and Indonesia's comparative export advantages have decreased over the study period, as is seen in the declining RCA values. For example, Spain's RCA^{GLS} value dropped from 1.39 during 1998-2000 to 0.23 during 2013-2016. Indonesia's RCA^{GLS} value decreased from 2.56 to 1.82. As discussed above, these findings agree with a reduction in their export shares of canned tuna in the global market. In contrast, the Philippines export competitiveness in canned tuna has increased over the study period. This is seen in a shift in most of the country's RCA indices (see Table 3-13). This is because the Philippines has lower production costs. The Philippines has its own tuna fleets and can access tariff preferences provided by the EU and US markets (Campling et al., 2007).

Thailand has faced declining export competitiveness in canned pineapple. Most RCA indices (BI, RCA^{V}, RCA^{HO} and RCA^{YCL}) decreased between 1998 and 2016 (see Table 3-14). As discussed above, the reasons are because of a decrease in available land for the cultivation of fresh pineapple and higher export prices, compared with competitors (The Office of Agricultural Economics, 2017; Wasusri et al., 2007). In contrast, the Philippines export competitiveness has improved during the same period. The Phillippine's RCA^{HO} increased from 23.34 during 1998-2000 to 44.35 during 2013-2016. The country's RCA^{GLS} increased from 25.77 to 30.64, during the same period. As discussed above, this is because of the Phillippine's ability to produce canned pineapple at a lower price. Indonesia's and the Netherlands' export competitiveness in canned pineapple is significantly lower than Thailand's (see Table 3-14). In particular, the RCA^{U}, RCA^{V} and RCA^{GLS} indices reveal that the Netherlands was not able to achieve an export comparative advantage in canned pineapple during 1998-2016. This is seen in the negative RCA values for the country. Although the Netherlands is in the top five exporters of canned pineapple in the world market, the re-export phenomenon contributes to the exports. Kenya has the highest export competitiveness among the top five exporters of canned pineapple. Most RCA indices for Kenya were higher than other exporters' (see Table 3-14). However, Kenya's export comparative advantage continuously decreased during 1998-2016. This is seen in the reductions of most of its RCA values. This finding agrees with that market share and export price analysis' results. As shown in Tables 3-9 and 3-10, Kenya's export share of the canned pineapple market has decreased while the price of Kenyan canned pineapple exports increased.

Table 3-13 The RCA Indices of the Key Exporters of Canned Tuna

Exporters	Period					
Thailand	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	43.40	36.01	36.67	34.70	32.30	27.43
RCA^{U}	1.00	1.00	0.99	0.96	0.92	0.90
RCA^{V}	68.86	56.70	60.82	58.43	53.52	40.85
RCA^{L}	0.95	0.95	0.95	0.94	0.94	0.93
RCA^{HO}	101.08	98.48	95.50	100.99	102.07	97.95
RCA^{YCL}	0.85	1.01	1.04	1.20	1.29	1.25
RCA^{GLS}	36.16	35.22	35.91	36.09	35.59	30.65
Ecuador	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	98.52	124.28	101.07	86.53	78.37	110.57
RCA^{U}	1.00	1.00	1.00	1.00	0.99	1.00
RCA^{V}	107.53	141.98	114.84	98.17	89.22	127.56
RCA^{L}	0.98	0.98	0.98	0.98	0.97	0.98
RCA^{HO}	231.64	350.62	267.83	253.51	257.61	404.13
RCA^{YCL}	0.15	0.27	0.26	0.28	0.33	0.50
RCA^{GLS}	27.87	42.98	42.33	41.57	41.74	56.55
Spain	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	6.79	6.24	5.60	5.59	5.90	4.82
RCA^{U}	0.53	0.52	0.20	0.06	0.09	0.05
RCA^{V}	6.48	5.82	3.99	3.15	2.65	1.27
RCA^{L}	0.74	0.72	0.70	0.70	0.71	0.66
RCA^{HO}	13.72	14.51	12.30	13.76	15.93	14.10
RCA^{YCL}	0.21	0.27	0.23	0.25	0.27	0.25
RCA^{GLS}	1.39	1.49	0.65	0.23	0.38	0.23
Indonesia	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	7.36	5.50	5.54	4.72	4.44	5.22
RCA^{U}	0.97	0.99	0.99	0.99	0.99	0.97
RCA^{V}	7.63	5.69	5.73	4.87	4.59	5.38
RCA^{L}	0.76	0.69	0.69	0.65	0.63	0.68
RCA^{HO}	15.10	12.68	12.14	11.12	11.39	15.59
RCA^{YCL}	0.11	0.11	0.10	0.10	0.12	0.15
RCA^{GLS}	2.56	2.15	2.05	1.74	1.89	1.82
Philippines	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	11.72	9.22	7.97	15.96	14.96	14.99
RCA^{U}	1.00	1.00	0.99	1.00	1.00	0.99
RCA^{V}	12.43	9.62	8.24	16.93	15.69	15.88
RCA^{L}	0.82	0.80	0.76	0.87	0.87	0.86
RCA^{HO}	25.41	23.47	18.50	45.95	45.80	53.13
RCA^{YCL}	0.12	0.12	0.08	0.15	0.14	0.17
RCA^{GLS}	9.15	7.83	5.43	8.01	6.85	6.84

Source: Author's computation

Table 3-14 The RCA Indices of the Key Exporters of Canned Pineapple

Exporters	Period					
Thailand	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	48.24	40.11	40.17	41.61	39.93	36.35
RCA^{U}	1.00	1.00	1.00	1.00	1.00	1.00
RCA^{V}	82.54	67.31	70.87	81.92	79.99	67.31
RCA^{L}	0.96	0.95	0.95	0.95	0.95	0.95
RCA^{HO}	38.42	32.35	29.24	28.84	25.20	24.10
RCA^{YCL}	0.33	0.33	0.32	0.34	0.32	0.31
RCA^{GLS}	41.38	40.85	41.29	46.67	46.31	43.27
Philippines	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	31.23	29.84	32.04	40.87	55.15	63.54
RCA^{U}	1.00	1.00	1.00	1.00	1.00	1.00
RCA^{V}	36.69	35.02	36.87	47.35	66.42	82.42
RCA^{L}	0.93	0.93	0.94	0.95	0.96	0.97
RCA^{HO}	23.34	23.59	23.19	28.47	34.92	44.35
RCA^{YCL}	0.11	0.12	0.10	0.09	0.10	0.15
RCA^{GLS}	25.77	26.24	22.67	22.26	24.94	30.64
Indonesia	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	12.63	14.55	14.67	12.59	12.09	14.57
RCA^{U}	1.00	1.00	1.00	0.99	1.00	1.00
RCA^{V}	14.04	16.45	16.58	14.19	13.77	16.82
RCA^{L}	0.84	0.87	0.87	0.84	0.85	0.87
RCA^{HO}	10.02	11.24	10.23	8.41	7.15	9.34
RCA^{YCL}	0.08	0.09	0.08	0.08	0.08	0.09
RCA^{GLS}	4.75	5.96	5.74	4.94	5.25	5.23
Kenya	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	296.34	333.76	190.42	179.11	136.96	166.31
RCA^{U}	1.00	1.00	1.00	1.00	1.00	1.00
RCA^{V}	328.52	374.31	205.32	193.13	144.84	178.30
RCA^{L}	0.99	0.99	0.99	0.99	0.99	0.99
RCA^{HO}	228.17	273.25	142.07	125.54	87.68	111.40
RCA^{YCL}	0.06	0.07	0.04	0.04	0.03	0.04
RCA^{GLS}	57.57	71.46	50.41	48.35	34.24	40.19
Netherlands	1998-2000	2001-2003	2004-2006	2007-2009	2010-2012	2013-2016
BI	1.60	1.08	0.97	1.12	1.08	0.96
RCA^{U}	-0.22	-0.13	-0.19	-0.14	-0.09	-0.08
RCA^{V}	-0.01	-0.16	-0.47	-0.37	-0.27	-0.27
RCA^{L}	0.19	0.00	-0.02	0.05	0.04	-0.03
RCA^{HO}	0.41	0.04	-0.02	0.09	0.05	-0.04
RCA^{YCL}	0.01	0.00	0.00	0.00	0.00	0.00
RCA^{GLS}	-0.79	-0.33	-0.63	-0.49	-0.32	-0.26

Source: Author's computation

3.5 Chapter Summary

During 1998-2016, most Thai processed food has been produced for export. Developed countries are the key importers of Thai processed food. Interestingly, over the study period, developing countries, especially ASEAN countries, have become increasingly important as optional export destinations. Some TPFPs have been at the top of world rankings, i.e., processed shrimp, processed chicken, canned tuna and canned pineapple. These products have mostly been exported to developed countries such as the U.S., Japan and European countries.

MNEs, which have been the key buyers of TPFPs, control Thai production mainly via product standards. Thus, various forms of governance are evident. The form of governance used depends on several factors, such as the complexity of information, the producers' capabilities, and product characteristics. For example, Thailand's processed shrimp and chicken value chains are captive and hierarchical governance. This is because the production processes are governed by food safety standards. The captive and hierarchical governance forms also explain the economic transactions in the Thai canned tuna industry. In contrast, the Thai canned pineapple value chain is market governance; most economic transactions depend on product prices. This is because canned pineapple is produced in simple forms and does not have to meet the food safety standards as do processed shrimp and chicken.

This chapter also analysed Thailand's (and its competitors') export competitiveness using a variety of methods (market share, export price and RCA indices). Based on the findings, the Thai processed shrimp industry has faced decreasing export competitiveness during the period 1998-2016. Both market share and RCA values of the industry has reduced significantly during the study period. Vietnam, India and China have increased in importance as key competitors. Their export prices of processed shrimp were lower than Thailand. The RCA indices indicate that Vietnam has comparatively more export advantages than Thailand. In contrast, Thailand's processed chicken industry has exhibited striking export competitiveness over the same period. Thailand's processed chicken export share and RCA values were higher than those of its competitors (China, the Netherlands and Germany). Thailand's export competitiveness in canned tuna has decreased over the study period as seen by a decrease in both market share and RCA values of the industry. Ecuador has become a key competitor. Ecuador's canned tuna export share has been steadily increasing. Most Ecuadorian RCA values were higher than Thailand. The Thai canned pineapple export share of the world market was 40% higher during the period 1998-2016. However, a reduction in available land for the cultivation of fresh pineapple has recently contributed to a reduction in export share of the industry. In contrast, the Philippines' canned pineapple export share has continuously increased; most RCA values indicate that the Philippines has higher export competitiveness than Thailand.

Chapter 4

Data and Methods

Chapter Four provides the literature, methodology and empirical models used to assess the impact of economic and social upgrading on TPFEs, including identification of the key determinants influencing the upgrading types of TPFS. The chapter is divided into five sections. Section 4.1 provides an overview of the literature on economic and social upgrading measures and the models to evaluate the impact of economic and social upgrading on exports. Section 4.2 outlines the methodology, the empirical model and the econometric procedure used to assess the impact of economic and social upgrading on TPFEs. To identify the key determinants influencing economic and social upgrading of TPFS, Section 4.3 discusses the relevant literature. Section 4.4 presents the methodology, the empirical model and the econometric procedure used to identify the key determinants influencing the upgrading types of TPFS. Section 4.5 summarises the chapter.

4.1 The Impact of Economic and Social Upgrading on Exports: Literature Review

4.1.1 Measurement of Economic and Social Upgrading

One of the key challenges in analysing economic and social upgrading impact on exports is how to measure economic and social upgrading in quantitatively. Although there are many empirical studies that provide definitions for economic and social upgrading, there is continuing debate about how to accurately measure upgrading. Previous studies provided various methods to measure upgrading. This section gives an overview of the literature on the measures of economic and social upgrading.

4.1.1.1 The Measurement of Economic Upgrading

As discussed in Chapter 2, economic upgrading includes product upgrading, process upgrading, functional upgrading and inter-sectoral upgrading. The section below discusses how to measure the upgrading types.

1) Product Upgrading

Product upgrading is improving product quality (Kaplinsky & Readman, 2005; Ponte & Ewert, 2009; Tham et al., 2016). According to the literature, the measurement of product upgrading in quantitative terms has two perspectives. The first perspective demonstrates that product quality is represented by an increase in product price or export unit values that are commonly measured using the total export value divided by the total quantity of exports (Aiginger, 1997; Tham et al., 2016). This is because product quality reflects changes in consumer preferences and, consequently, product price. This leads

to different prices for high and low quality product; higher-quality product sells for more than lower-quality product (Aiginger, 1997; Hallak, 2006; Ponte & Ewert, 2009; Tham et al., 2016). However, some researchers identified problems using product price to represent product quality. This is because an increased price may reflect an increase in production costs or inefficient production. If the increase in product price is related to either of these, then using product price as a measure of product upgrading will lead to wrong conclusions (Bernhardt & Milberg, 2011a; Kaplinsky & Readman, 2005).

To avoid fallacious interpretations when using product price as a proxy for product quality, the second perspective uses market share combined with product price to determine product quality (Bernhardt & Milberg, 2011a; Kaplinsky & Readman, 2005; Salido & Bellhouse, 2016). Kaplinsky and Readman (2005) argue that producers often try to improve their product to sell them at a higher price. However, as with the first perspective, a higher price may reflect production inefficiencies. Hence, to provide a more accurate measurement of product upgrading, it is necessary to include an indicator of cost competitiveness in combination with product price. Kaplinsky and Readman (2005) state that producers who are not cost-competitive often experience a reduction in their world market share. In short, market share reflecting competitiveness in the global trade is used to indicate product upgrading combined with product price. That is, product upgrading of each product is occurs when there is both an increase in product price and market share for the product (Kaplinsky & Readman, 2005; Milberg & Winkler, 2011).

Bernhardt and Milberg (2011a) support Kaplinsky and Readman's (2005) argument that product upgrading occurs when the product price and the market share of a product increase. Bernhardt and Milberg (2011a) provide a composite index that can be used to evaluate product upgrading. They use this index to evaluate product upgrading in four sectors in a variety of countries: horticulture, apparel, tourism and mobile telephones. The index uses a combination of changes in market share and product price. If the index value is positive, it means that product upgrading has occurred. If the value is negative, then the product has been downgraded.

Although some empirical studies present specific methods to calculate product quality, these methods are still based on product price and market share. In particular, they argue that increases in product price and market share can explain improvements in product quality (Hallak & Schott, 2011; Khandelwal, 2010; Olper et al., 2014). For example, Khandelwal (2010) requires production data of a product to estimate the quality of that product. Khandelwal et al. (2013) propose using the elasticity of substitution to measure product quality. However, these two methods have limitations in applying them to a number of products and countries. The use of Khandelwal's (2010) method may suffer from a lack of production data for some countries, especially developing countries (Khandelwal, 2010; Olper et al., 2014). Curzi and Pacca (2015) state that the elasticity of substitution, which is required for

Khandelwal et al.'s (2013) method, is somewhat difficult to calculate, especially for food products. This means that Bernhardt and Milberg's (2011a) index may be less precise than the product quality index generated by the methods in Khandelwal (2010) and Khandelwal et al. (2013). However, Bernhardt and Milberg's (2011a) index does not suffer from any lack of product data or the estimate of the elasticity of substitution. This means that Bernhardt and Milberg's (2011a) index can be applied to a wider range of products and countries, especially to food products and developing countries. Accordingly, the index is widely used (Bernhardt, 2013; Lee & Gereffi, 2013; Salido & Bellhouse, 2016).

2) Process Upgrading

Process upgrading occurs when producers can transform inputs to outputs more efficiently through the reorganisation of relevant production activities (Giuliani et al., 2005; Hansen et al., 2016). However, there is a clear gap in the literature on how to measure process upgrading quantitatively. A review of the relevant literature reveals that there are no specific methods that are used to measure process upgrading. Previous research has used some variables as a proxy for process upgrading. For example, in the agri-food sector, a decrease in the number of import refusals is used as a proxy for process upgrading. If developing countries need to meet food safety standards (usually proposed by the developed countries), they often need to upgrade their production processes. Therefore, the number of import refusals should decrease once they meet the food safety requirements (Baylis et al., 2010; Jongwanich, 2009; Jouanjean, 2012). Pavlinek and Zenka (2011) use production capital intensity (the capital-labour ratio) as a proxy for process upgrading in the automotive industry. They demonstrate that the capital-labour ratio can reflect a firm's investment in building, machinery and relevant instruments. This investment can lead to a rise in labour productivity as a result of process upgrading. However, Pavlinek and Zenka's (2011) measurement is not appropriate for process upgrading in the processed food sector because it cannot provide a complete picture of developments in production controlled by food safety standards that have significant impacts on traded processed food. Kaplinsky and Readman (2005) use product price and market share to measure process upgrading. They state that process upgrading emerges when product price decreases but market share increases. However, Kaplinsky and Readman's (2005) concept has some ambiguity. As discussed earlier, product upgrading occurs when the product price and market share increase. Thus, if process upgrading occurs, product upgrading will not occur. This seems to be contradictory in the agri-food sector since product and process upgrading are positively correlated (Ponte & Ewert, 2009).

3) Functional Upgrading

Functional upgrading emerges when producers can achieve new functions in GVCs, such as moving from assembly activities to distributor (Haakonsson, 2009; Pananond, 2012). Empirical research uses particular variables as proxies to measure functional upgrading. For example, some research shows that changes in OFDI can indicate that functional upgrading has occurred. Moving from being a domestic producer to an overseas distributor often requires increasing OFDI in overseas countries (Navas-Aleman, 2011; Pananond, 2012; Ponte & Ewert, 2009).

Some previous studies argue that export diversification can be a proxy for functional upgrading. Kowalski et al. (2015) note that export diversification can capture new export functions in an economy, e.g., moving from export of goods to export of services. This is an example of a country achieving functional upgrading. However, the main problem of using export diversification as a proxy for functional upgrading is that lack of methods to estimate export diversification. Also, export diversification can exemplify a condition where countries only change their export destinations while continuing to export the same product(s) (Tanrattanaphong, 2012). This is not an example of functional upgrading because it does not reflect that countries can achieve new functions in GVCs.

4) Inter-sectoral Upgrading

Inter-sectoral upgrading occurs when firms move into new productive activities in GVCs. In short, firms leverage some knowledge acquired from a current chain to insert their business into a new industry (Knorringa & Pegler, 2006; Moazzem & Sehrin, 2016). There are clear definitions of inter-sectoral upgrading, but measuring it is much more difficult. The term inter-sectoral upgrading only explains upgrading from a general perspective. For instance, it suggests that countries can export new products. However, it does not show what aspects of a given firm/country should be upgraded (Gibbon, 2008; Ponte & Ewert, 2009). Hence, there is still a lack of research on measuring inter-sectoral upgrading and what variables should be used as proxies.

4.1.1.2 The Measurement of Social Upgrading

Social upgrading refers to improvements in entitlements and workers' rights. It consists of measurable standards (wages and employment conditions) and non-measurable features (such as enabling rights). Since non-measurable features are difficult to quantify, most empirical research focuses only on the measurable standards as representative of social upgrading. For example, Bernhardt and Milberg (2011a) state that social upgrading occurs if both employment and real wages increase (or at least do not decrease). The authors construct an index that uses a combination of changes in employment rate and real wages to evaluate social upgrading in quantitative terms. If this index is positiver, it means that social upgrading has occurred. If the index is negative, then social downgrading has occurred. This method is widely used in empirical studies (e.g., Lee & Gereffi, 2013; Milberg & Winkler, 2011; Salido

& Bellhouse, 2016). Milberg and Winkler (2011) present an alternative measurement of social upgrading at the country level using proxy variables, such as wage growth, the human development index and poverty reduction.

4.1.2 Models to Measure the Impact of Economic and Social Upgrading on Exports

A literature review shows that analysing the impact of important variables (such as macroeconomic variables and variables related to economic and social upgrading) on exports can be categorised into two broad subgroups: non- gravity and gravity models.[18]

4.1.2.1 Non Gravity Model

The non-gravity group investigates the relationships between exports and the independent variables by using various econometric methods. These depend on the researcher's specific interests as well as the characteristics of the dataset. For example, Athukorala and Sen (1998) examined several independent variables' impact (outward orientation, trade policy regimes, growth rate per capita income and population) on the growth rate of developing countries' processed food exports. The authors use panel data and Pooled-Ordinary Least Square (Pooled-OLS) to achieve their results. Marchant, Saghaian and Vickner (1999) focussed on the relationship between the U.S. FDI and U.S. processed food exports to China. Marchant et al. (1999) investigated the relationship using the Two-Stage Least Square (2SLS) model to address the endogeneity problem between FDI and exports. Nordås (2008) examined infrastructure indices' impact (such as road, rail and airport densities) on the export share of aggregated and some disaggregated products (apparel and electronics). Nordås' dataset is characterised as cross-sectional data and the author uses Ordinary Least Square (OLS) to analyse the impact. Türkcan and Saygili (2018) investigated economic integration agreements impacts on Turkish export using the probit model. Their main findings revealed that the impact varied. The agreement had a positive impact on existing export products, but a negative impact on new export products.

Previous studies have used variables related to economic and social upgrading (e.g., the number of import refusals and OFDI) to explain economic and social upgrading. For example, for process upgrading, Jongwanich (2009) considers food safety requirements' impact on developing countries' processed food exports. Jongwanich notes that if a country can succeed in improving its production of processed food to meet food safety standards, its export value per number of import refusals will increase. The author hypothesises that developing countries face restrictions on their processed food exports because of food safety standards such as SPS. The author uses panel data, Fixed and Random-Effected models (FEM and REM) and 2SLS to test the hypothesis. Jongwanich argues that if developing countries fail to comply with SPS standards, developing countries' processed food exports will

[18] See the Table C-1 for the summarisation of the literature review in Appendix C.

decrease. Previous research has considered the importance of OFDI to exports (in terms of functional upgrading). Kim (1998) investigated the relationship between OFDI and exports among East Asian countries. The author's results show that OFDI does not affect exports if OFDI is small. Ahmad et al. (2016) investigated the relationship between OFDIs, ASEAN countries and their exports during 1981-2013 using OLS estimation. They find that with an increase in OFDIs ASEAN countries exhibits significant, positive effects on their exports.

With social upgrading, previous scholars have used variables related to social upgrading to explain export growth. For instance, Bonnal (2010) applied work injuries, and strike and lockout rates to represent labour standards. Bonnal applied the Generalised Method of Moment (GMM) estimation and finds that higher labour standards result in an increased exports to GDP ratio. In addition, some scholars have found that higher education is positively related to export growth. In short, higher skill levels encourage an expansion in exports. For example, Dehejia and Samy (2004) investigated the relationship between labour education level and the exports to GDP ratio. They employ OLS estimation to show that a shift in labour education levels leads to an increasing ratio of exports to GDP. Sahu (2016) used OLS estimation to analyse factors, such as GDP and education level, on Malaysian value-added exports. Sahu's results support Dehejia and Samy's (2004) findings that personal development leads to export growth.

4.1.2.2 Gravity Model

1) The Gravity Equation

The gravity model is considered the workhorse for modelling bilateral trade flows. Over recent decades, the gravity model has been used to investigate both trade supporting and trade impeding policies on trade flows (Chaney, 2018; Linnemann, 1966; Otsuki et al., 2001; Wood et al., 2017). The gravity model is based on the universal law of gravityation developed by Sir Isaac Newton. According to that law, the force intensity between two objects in the universe is directly proportional to the product of their mass and inversely proportional to their geographic distance. Applying this law to bilateral trade flows, Tinbergen (1962), the pioneer, argued that bilateral trade between two countries is directly proportional to their economic size (measured by GDP) and inversely proportional to the geographic distance between them. In short, the two countries will likely increase trade between them if their economic size is large and they are geographically close, and vice versa, as illustrated by equation (4.1):

$$T_{ij} = \alpha \frac{GDP_i^{\beta_1} . GDP_j^{\beta_2}}{Distance_{ij}^{\beta_3}} \quad (4.1)$$

where T_{ij} is the trade flow between counties i and j,

α is the control variable,

GDP_i is the GDP of country I,

GDP_j is the GDP of country j, and

$Distance_{ij}$ is the geographic distance between countries i and j.

Equation (4.1) shows that trade between countries i and j is positively correlated with their respective GDPs, but negatively correlated with the geographic distance between them. The parameter α is the control variable that captures the impact of other policies/strategies on the trade flows (bilateral exchange rates, trade agreements, and population). In addition, most studies use logarithms on both sides of the equation to transform equation (4.1) to a linear form (Athukorala, 2012; Burger et al., 2009; Chaney, 2018; Papazoglou, 2007). After taking logarithms of both sides, we have the log-linear transformation of equation (4.1) with the disturbance term and time as in equation (4.2).

$$\ln T_{ijt} = \ln\alpha + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} - \beta_3 \ln Distance_{ij} + \varepsilon_{ijt} \quad (4.2)$$

where: T_{ij} is the trade flow between counties i and j in year t,

α is the control variable,

GDP_i is GDP of country i at year t,

GDP_j is GDP of country j at year t,

$Distance_{ij}$ is the geographic distance between countries i and j, and

ε_{ijt} is assumed to be independent and identically distributed (i.i.d.).

T_{ij} can be measured as partial analysis, export or import values. It can also be measured as total analysis, export plus import values. The GDP form used in the gravity model can be used as the product form of GDP (GDP_i*GDP_j). This is called total analysis. In contrast, the GDP of countries i and j can be separated. This is called partial analysis (Akhter & Ghani, 2010; Nguyen & Wilson, 2009; Sohn, 2005). Finally, the control variable (α) represents other independent variables related to trade flows.

2) The Independent Variables used in the Gravity Equation

Focusing on the independent variables, the GDP of both the exporting and importing countries and distance are added as exogenous variables to the gravity model. Sometimes these are called "conventional variables". GDP is defined as the growth engine of trade flows. For example, if an exporting country's GDP increases, this leads to export growth because of a shift in productive capacity. In contrast, an increase in an importing country's GDP can indicate an increase in the ability

to import. Consequently, a positive GDP coefficient is expected (Gebrehiwet et al., 2007; Jongwattanakul, 2012; Jordaan, 2015). Some empirical research suggests that the GDP's coefficient can be interpreted in another way. That is, larger economies tend to rely less on international trade. If this occurs, a negative relationship between trade and GDP is likely (Alesina & Wacziarg, 1998; Mulapruk & Coxhead, 2005). Moreover, GDP can be insignificant to trade. This is because, when analysing a specific product and a particular market, exporting or importing values are less significant in terms of GDP (Gebrehiwet et al., 2007; Kareem, 2013; Mulapruk & Coxhead, 2005). Hence, it is unlikely that GDP will affect export and import expansion. As a result, several studies have used related variables (such as GDP per capita) instead of GDP when examining a specific product and a particular market (Otsuki et al., 2001; Thuong, 2017). The distance variable is an impedance variable. Accordingly, a negative distance coefficient normally emerges. This means that if the geographic distance between the two countries is great, they are less likely to trade with one another (Athukorala, 2009; Jongwattanakul, 2012).

The gravity model has been augmented by several scholars who have added other independent variables, e.g., GDP per capita, population, and geographic variables (common borders and regions) (Brooks & Ferrarini, 2012; Devadason, 2011; Paas et al., 2008). GDP per capita is normally used as a proxy for a country's income level or purchasing power. Previous studies have shown that both importers' and exporters' GDP per capita can be positively and negatively correlated with trade flow (Glick & Rose, 2002; Schumacher, 2003; Sohn, 2005). An exporting country's GDP per capita is commonly interpreted as a proxy for the country's capital-labour ratio. If a positive relationship between GDP per capita and exports is found, this means that export products are capital-intensive. Exporting countries are classified as being labour-intensive if the relationship between GDP per capita and exports is negative. An importing country's GDP per capita is commonly represented as purchasing power. A positive relationship between an importing country's GDP per capita and an exporting country's export values indicates that the products traded between the two countries are luxury items. In contrast, a negative relationship indicates that the products are necessities (Bergstrand, 1989; Egger, 2002; Schumacher, 2003).

The effect of population (of both the exporting and importing countries) on trade flow is ambiguous; it may be positive or negative (Egger & Pfaffermayr, 2003; Martinez-Zarzoso & Nowak-Lehmann, 2003; Thuong, 2017). On one hand, an increase in population results in expansion of the domestic market. That situation creates greater opportunities for trade in a wide range of products. On the other hand, an increasing population may denote larger resource endowment, a larger domestic market or self-sufficiency. This leads to less reliance on international trade. Thus, there will be a negative relationship between population and trade flow.

Previous studies have added geographic variables such as common border and popular geographic variables, into the gravity model and examined their impact on trade. For example, Tripathi and Leitão (2013) and Wilson et al. (2003) argue that if two countries share a common border, trade between the two countries tends to increase. However, some previous research suggestes that a common border might negatively affect trade flow because of the political environment (e.g., trade flow between India and Pakistan) (Gul & Yasin, 2011).

Additionally, previous research has improved the gravity model to analyse policies/strategies' impact (e.g., trade policies, macroeconomic variables, and economic and social upgrading) on trade flow. For trade policy, some research has focused on tariff policy impact on trade flows and acknowledges that import taxes and trade flows are negatively correlated (Akhter & Ghani, 2010; Brooks & Ferrarini, 2012; He et al., 2013; Oguledo & Macphee, 1994). Some scholars have paid attention to non-tariff barriers and trade negotiations impacts (e.g., Free Trade Areas (FTAs)) on international trade. This is because the main purpose of the WTO's trade negotiations is to reduce tariff barriers in global markets. However, it is difficult to conduct the WTO's trade negotiation because many countries try to protect their benefits as much as possible. As a result, many countries pay attention to bilateral trade agreements (such as FTAs), rather than multilateral trade agreements (Kohpaiboon, 2006; Phongpaichit & Baker, 2002). In addition, many countries shift their interest from using tariff barriers to protect their benefits in global markets (e.g., local industry protection within countries) to using non-tariff barriers (such as product standards). For instance, with the internationalisation of food habits during the past three decades, global buyers have become increasingly concerned about food safety and quality issues (Athukorala et al., 2002). Various product standards are used to control the production of several product categories, particularly in the agri-food sector.

Some studies consider the role of SPS and HACCP standards in international trade. These standards are used as independent variables in the gravity model. Some research used variables related to food safety and food quality issues, such as the number of import refusals or the level of pesticide residues in relation to trade flows (Anders & Caswell, 2009; Disdier et al., 2007; Li & Beghin, 2012; Otsuki et al., 2001). These studies insist that developing countries have been negatively impacted by the standards, especially in the trade pattern south to north (exports from developing countries to developed countries) (Disdier et al., 2007; Gebrehiwet et al., 2007; Otsuki et al., 2001). Some scholars focus on the impact of trade negotiations on trade flows, e.g., how FTAs affect bilateral trade. The variable - FTAs - is added to the gravity model as a key independent variable, either in the form of a dummy variable or a constructed index (Bensassi et al., 2015; Gul & Yasin, 2011; Noguera, 2012; Tang, 2005). However, previous studies showed that FTAs could be either significant or insignificant to trade flows. If FTAs are based on important characteristics related to bilateral trade, such as a trade volume and trade specialisation in export products, they support an increase in trade flow between two countries.

In contrast, if FTAs respond to a political relationship, regardless of the key characteristics of the two countries (e.g., low volume of trade flow), FTAs do not significantly affect trade flows. Furthermore, some FTAs result in major trade barriers such as product quality requirements and the Rule of Origin (RoO), which is a requirement criterion to prove a product's origin (Jongwattanakul, 2012; Kohpaiboon & Jongwanich, 2015).

Most studies add country development and macroeconomic variables into the gravity model to capture their impact on trade flow. For example, previous studies centred on the impact of trade facilitation on trade flow. Several other related variables are added into the gravity model, such as infrastructure indices (road density and port efficiency of importers and exporters, the Logistics Performance Index (LPI) and the customs environment) (Athukorala, 2012; Choi, 2013; Saslavsky & Shepherd, 2014; Shepherd & Wilson, 2009; Wilson et al., 2005). Previous studies report that trade facilitation has a positive impact on trade flow. Previous research has included macroeconomic variables (such as the real exchange rate) to examine trade flows (Athukorala, 2009; Carrère, 2006; Giorgio, 2004; Jongwattanakul 2012). These studies found that the real exchange rate has a positive impact on exporters but the reverse effect on importers. In short, exporting countries gain an advantage from an increased exchange rate (a devaluation of their currency). This means that the price of exports tends to be lower in the view of importers. However, the negative relationship between real exchange rate and exports is an indirect effect. When a real exchange rate appreciates, a country can import some intermediate products at a lower cost to produce its export products. Lowering production costs can increase exports. This situation usually occurs when a product (like a car) is produced in many parts in different countries. This is called a production network. Countries in the network need to collaborate across the production chain to ensure global optimisation (Jongwattanakul, 2012; Kohpaiboon, 2006).

Previous studies have also investigated the effect of major economic crises (e.g., the Asian financial crisis and the 2008 global financial crisis) on international trade. These studies add a dummy variable into their model to capture the effects on trade flows. The authors argue that financial crises have a negative impact on trade flows (Athukorala, 2012; Jongwattanakul, 2012).

Variables related to economic and social upgrading are used to explain trade flows. However, study of the impact of economic and social upgrading on exports is somewhat novel. Studies that used variables related to economic and social upgrading as independent variables in the gravity model are rare. For variables related to product upgrading, Lee (2015) applied Khandelwal'a (2010) quality ladder index to calculate product quality. Lee finds that product quality increases a country's imports. In short, countries tend to increase their imports as product quality increases. Baylis et al. (2010) used seafood product import refusals to analyse the role of process upgrading on trade values. They find that import

refusals and trade values have a negative relationship. This indicates that process upgrading (in this case, a lower number of import refusals) encourages an increase in trade value. Nguyen and Wilson (2009) use a dummy variable of SPS standards to analyse the trade flows of seafood products. They insist that, if countries fail to meet an SPS standard (failure to process upgrade), they face a severe reduction in their exports. For variables related to functional upgrading, previous research has considered OFDI's importance to exports. Hua (2013) and Lin (2016) both find that OFDI, at the current and lagged periods, has a positive impact on trade. Focusing on the social upgrading variable, Miroudot and Ragoussis (2009) added an educational level variable into their gravity model. They confirm a positive relationship between educational level and export growth.

Scholars use a variety of independent variables in the gravity model. The gravity model is improved by adding other independent variables, such as importer and exporter GDPs, distance, trade policies, macroeconomic variables, and economic and social upgrading, depending on the scope of each study. Economic and social upgrading are widely acknowledged as two key factors that contribute to export performance in modern trade, but there is a lack of research examining the impact of economic and social upgrading on exports. This is a significant knowledge gap. This study adds to knowledge in this area.

3) Data and Estimation Techniques for the Gravity Equation

The data and estimation techniques used in the gravity model vary (cross-sectional, time series and panel data). Panel data are most commonly used to estimate the gravity model. There are two ways to deal with panel data. First, some studies used OLS estimation to analyse the relationships between trade flow and the independent variables, like a cross-sectional data analysis (Bergstrand, 1985; Disdier et al., 2007). This can capture the impact of the independent variables on trade flow in a particular year, but it cannot consider the long term (Jongwattanakul, 2012).

The second method is a pooled study that can capture the impact of the independent variables on trade flow over long periods. Some scholars use Pooled-OLS estimation to handle the panel data (Akhter & Ghani, 2010; Athukorala, 2012; Saslavsky & Shepherd, 2014). However, since panel data consist of cross-sectional and time series data, there are often issues around the heterogeneous characteristics of exporting and importing countries and time effects. Baltagi et al. (2003), Egger and Pfaffermayr (2003), and Matyas (1997) acknowledge that the heterogeneity of (exporting and importing) countries' characteristics and time have significant impacts on trade flow. If the Pooled-OLS estimation technique is used to deal with panel data, it may produce biased estimates and misleading results (Baltagi et al., 2003; Egger & Pfaffermayr, 2003; Gujarati & Porter, 2005; Matyas, 1997). To avoid bias, many researches use the fixed and random effect approaches to deal with panel data. These approaches allow researchers to capture relationships over time and observe individual effects related

to exporting and importing countries (Bensassi et al., 2015; Giorgio, 2004; Martinez-Zarzoso & Nowak-Lehmann, 2003; Wilson et al., 2003). This leads to unbiased estimates and a correct investigation.

Since the gravity model is generally in a non-linear form, most studies take logarithms of both sides of the gravity equation to transform it from a non-linear to a linear equation (Glick & Rose, 2002; Jordaan, 2015; Oguledo & Macphee, 1994; Tinbergen, 1962). However, authors have argued that the log-linearised model estimated by OLS estimation does not work well with the gravity model (Burger et al., 2009; Santos Silva & Tenreyro, 2006; Wood et al., 2017). First, using the log-linearised estimation in the gravity model leads to biased estimators because of Jensen's inequality problem which indicates that the expected value of the logarithm of a random variable is not equal to the logarithm of its expected value (Santos Silva & Tenreyro, 2006). Secondly, the log-linearised model estimated by OLS assumes that the error term is homoscedastic, which leads to inefficient results. Although fixed effects are controlled for, the heteroskedasticity problem persists when the gravity equation is estimated in the log-linearisation form (Santos Silva &Tenreyro, 2006). Finally, the use of the log-linear form of the gravity equation cannot handle zero-value trade flows because of the logarithm rule, the undefined zero logarithm (Burger et al., 2009; Santos Silva & Tenreyro, 2006). Thus, zero-value trade flows must be omitted from the data for the log-linearised model, even though zero-value trade flows may be important information and non-randomly distributed. This leads to biased, inefficient estimates (Burger et al., 2009; Santos Silva & Tenreyro, 2006).

To address these problems, scholars have introduced the Pseudo Maximum Likelihood (PML) estimation technique (e.g., modified Poisson specification) to deal with the gravity equation (Burger et al., 2009; Santos Silva & Tenreyro, 2006). Gourieroux et al. (1984) introduced the PML estimation technique. Applying this method to the linear exponential family with the multiplicative form (e.g. the Poisson model) provides better results in terms of low bias estimates (Gourieroux et al., 1984; Santos Silva & Tenreyro, 2006; Staub & Winkelmann, 2011). Although some studies use truncation and censoring methods to deal with the problem of zero-value trade flows, Burger et al. (2009) and Gómez-Herrera (2013) claim that applying these methods leads to inconsistent estimates.

In addition, the PML method can deal with a response variable, even though it has a non-negative continuous value. For example, the Poisson model estimated by the maximum likelihood (ML) technique cannot deal with a dependent variable that has a non-negative continuous value. In contrast, applying the PML method with the Poisson model can deal with a dependent variable with non-negative continuous values. This is useful when using the PML with the gravity model because the dependent variable of the gravity equation are usually trade values that are non-negative and continuous (Gourieroux et al., 1984; Santos Silva & Tenreyro, 2006; Wooldridge, 2002).

Santos Silva and Tenreyro (2006) note that the traditional gravity equation can be written as an exponential function with the multiplicative form (constant-elasticity model). It is denoted by $E(T_{ij}|Y_i, Y_j, D_{ij},) = \exp(\ln\alpha_0 + \alpha_1 \ln Y_i + \alpha_2 \ln Y_j + \alpha_3 \ln D_{ij})$, where T_{ij} is trade flow between country i and j, Y_i is GDP of country i, Y_j is GDP of country j, and D_{ij} is the distance between the two countries. Santos Silva and Tenreyro (2006) suggest that applying the PML estimate, with some exponential families (especially Poisson family), should become the new workhorse to deal with the gravity equation. The Nonlinear Least Squares (NLS) method can also be applied to the gravity equation, but it requires many assumptions and requirements. For example, researchers need large samples and the definite form of conditional variance (Santos Silva & Tenreyro, 2006; Wooldridge, 2002[19]). To prove the PML estimation performance with the gravity model, Santos Silva and Tenreyro (2006) developed the constant-elasticity model (which contains the heteroscedasticity problem in the model) and use the Poisson Pseudo Maximum Likelihood (PPML) estimation to regress the model. Santos Silva and Tenreyro (2006) also use other estimation techniques, such as NLS and the Gamma Pseudo Maximum Likelihood (GPML) to deal with the constant-elasticity model to compare the estimate performance between PPML and other techniques. Their findings confirm that PPML estimation can deal with the constant-elasticity model and provide robust, superior results to other techniques (e.g., NLS and GPML) even though the model contains heteroscedasticity.

However, there are weaknesses in the PPML estimation method. First, there is the overdispersion problem. Since the major assumption of the Poisson model is equidispersion, estimates may be incorrect if this assumption is violated (Burger et al., 2009). According to the equidispersion assumption, the conditional variance is equal to the conditional mean. However, the conditional variance is often higher than the conditional mean. As a result, the variance should be specified as a function of the conditional mean and a dispersion parameter (Burger et al., 2009). To solve this problem, Burger et al. (2009) suggest that the Negative Binomial Pseudo Maximum Likelihood (NBPML) is more suitable to deal with the gravity model. This is because NBPML estimation relaxes the equidispersion assumption for the Poisson model by adjusting the degree of dispersion in the predictions.

Secondly, trade data may have excessive zeros in trade values, when focusing on high levels of disaggregated products (HS-6 or HS-8 digits) or studying small countries' trade flows (Burger et al., 2009, Kareem et al., 2016). This is because, when excessive zeros are derived from the non-Poissoness[20], the number of zeros in trade flows is likely to be greater than the number of zeros

[19] See more details at the page numbers; 645-656.

[20] Burger et al. (2009) indicate that one important cause of non-Poissoness is when some zeros in the observation are produced by a different process compared to the remaining observations (including other zeros).

predicted by the model. Applying PPML and NBPML estimates to the gravity equation containing excess zero-value trades may lead to incorrect estimates (Burger et al., 2009).

Some studies use the zero-inflated model as an alternative to deal with the problem of zero-value trade flows (Kareem et al., 2016; Philippidis et al., 2014; Tran et al., 2012). Two important zero-inflated estimation techniques, the Zero-Inflated Pseudo Maximum Likelihood (ZIPML) and the Zero-Inflated Negative Binomial Pseudo Maximum Likelihood (ZINBPML), can deal with the problem of frequent zero values in trade flows (Burger et al., 2009; Philippidis et al., 2014; Tran et al., 2012). A key advantage of ZIPML and ZINBPML is that these methods can deal with an excessive number of zeros in trade value. These zeros are from two different sources: Poissoness and non-Poissoness. The Poisson group refers to countries that do not presently trade but could do so in the future. The non-Poisson group refers to countries that never trade, which leads to data with zero counts (Kareem et al., 2016). For example, in the Poisson group, the number of zeros in trade flows relates to huge distance or large differences in country pair preferences and specialisation. In the non-Poisson group, the zero-value trade flows may relate to a lack of trade through reasons such as bans or trade embargoes (Kareem et al., 2016). However, based on the literature, both ZIPML and ZINBPML have limitations, particularly with panel data, via common statistical software (STATA and Eviews) (Allison, 2011; Cameron & Trivedi, 2009; StataCorp LLC., 2017). Hence, most studies that use ZIPML and ZINBPML to deal with the gravity model use cross-sectional data (e.g., average yearly trade value and a single year) (Burger et al., 2009; Metulini et al., 2018).

As discussed earlier, some scholars have identified weaknesses (related to overdispersion and excessive zeros in trade values) with the PPML method. However, Santos Silva and Tenreyro (2011) and Staub and Winkelmann (2011) argue that PPML estimation still provides better results even though these two problems exist in the gravity model. To prove the estimation performance of the PPML method with excessive zeros, Santos Silva and Tenreyro (2011) generated their dataset with a constant-elasticity model with excessive zeros and rich heteroskedastic patterns. Interestingly, their Monte Carlo simulation results indicate that the PPML estimation still provides accurate results (with low biases) although the dataset has a massive number of zeros and heteroskedastic patterns. Staub and Winkelmann (2011) contend that the overdispersion and excessive zeros problems have fewer effects on the PPML estimates.

Martinez-Zarzoso (2013) states that choosing the best estimator depends on the choice of data. There is no specific estimation technique that can deal with all datasets, although there are various techniques to deal with the gravity equation, such as the FEM and REM, PPML, NBPML and Zero-Inflated models. As a result, it is better to use a few different methods rather than one specific one to deal with the gravity model.

4) Country Analysis and the Gravity Equation

Country analysis patterns used in the gravity model vary. Previous studies have focused on multiple countries (such as developing countries) to analyse the independent variables' impact on trade flows (Brooks & Ferrarini, 2012; Francois & Manchin, 2013). By using multiple countries in the gravity model, researchers can access a large sample to investigate the independent variables' impact on trade, but they cannot determine how the independent variables affect the trade flow of each specific country. In contrast, Jongwattanakul (2012) and Tripathi and Leitão (2013) argue that each independent variable may affect each country differently. Thus, Jongwattanakul (2012) and Tripathi and Leitão (2013) focus on a specific country and investigate how the independent variable affects the trade flows of that country. Previous studies also suggest that there are four patterns of trade flow: South to South, South to North, North to South and North to North (Anders & Caswell, 2009; Giorgio, 2004). Each independent variable has a different impact on each trade flow pattern. For example, food safety standards are particular to the South to North pattern, but us less important in the North to North pattern (Anders & Caswell, 2009).

5) Product Analyses and the Gravity Equation

Previous research employed two forms of product in the gravity model. The first form is aggregate products. Some studies have used aggregate products to investigate the independent variables' affects on trade flows (Gul & Yasin, 2011; Martinez-Zarzoso & Nowak-Lehmann, 2003; Papazoglou, 2007). Conversely, some studies focus on disaggregated products (such as processed food, parts and components, and apparel). There is evidence to suggest that each product category is sensitive to different policies (Giorgio, 2004). For example, processed food is highly sensitive to policies related to food safety issues, but this is not so for the automotive sector. To understand the impact of trade policy on trade flows, researchers should focus on particular product categories, rather than aggregate products. The Office of Industrial Economics (2015) states that policymakers should avoid creating "one size fits all" policies. This is because the different characteristics of each product category need different policies to stimulate the growth of exports of the product. For instance, the automotive sector is a capital-intensive sector, whereas the processed food sector is classified as a labour-intensive sector. As a result, these two sectors should be supported by different policies.

4.2 Measuring Economic and Social Upgrading's Impacts on Thai Processed Food Exports

4.2.1 Empirical Model

This study uses the improved gravity model to investigate the impact of economic and social upgrading on TPFEs during 1998-2016. We use economic and social upgrading variables as additional control variables in the gravity model to capture their effect on TPFEs. Although prior research acknowledged

the importance of these two upgrading types to exports under GVCs (Gereffi et al., 2005; Ponte & Ewert, 2009; OECD, 2012), there are no empirical studies testing their impact on exports (especially processed food exports) using econometric methods. Previous studies used qualitative methods, such as surveys and interviews to investigate the importance of economic and social upgrading for exports (see, Gereffi, 2015; Ponte et al., 2014). Accordingly, this study applies economic and social upgrading as key independent variables to explain TPFEs and includes other conventional control variables such as GDP per capita, population, geographic variables (e.g., common borders), real exchange rates, trade negotiations and financial crises. This is because the study period covers significant financial crises and the development of numerous trade agreements. Previous studies suggest that these issues affect export structures (Bensassi et al., 2015; Jongwattanakul, 2012; Lee, 2015).

We also add process and functional upgrading lagged variables. This is because previous empirical research has acknowledged that the lagged variables of these two upgrading types impact exports. Focusing on the process upgrading lagged variable, empirical studies note that it is sometimes difficult to improve production processes to meet current food standards (Baylis et al., 2010; Jouanjean et al., 2015). Initially, processing companies/exporters need to invest huge amounts of capital to achieve the standards. This leads to a shift in production costs and, subsequently, an increase in product price. In addition, processing companies/exporters need to spend a lot of time learning how to comply with the product standards. As a result, the process upgrading lagged variable tends to positively impact current exports. For the functional upgrading lagged variable (usually represented by OFDI), previous research has indicated that both OFDI and its lagged variable have a positive impact on exports (Ahmad et al., 2016; Hua, 2013; Lin, 2016).

However, we do not use the inter-sectoral upgrading variable as an independent variable. As the literature review has shown, it is difficult to accurately calculate inter-sectoral upgrading in quantitative terms (Gibbon, 2008; Ponte & Ewert, 2009). Moreover, most Thai processed food exports are “made-to-order” products (Kohpaiboon, 2006). To produce new products for export, Thailand needs assistance from MNEs and knowledge about how to establish production systems and related technology. In short, it will be difficult for Thailand to start producing new products for export.

The second feature is related to product categories. Some research suggests that policies impact on each export product differently (Giorgio, 2004; Jongwattanakul, 2012). For instance, food safety standards are more important for processed foods than they are for the parts and components industries. Hence, this study uses disaggregated product, as opposed to aggregated product (total exports) with partial analysis. The study focuses on the TPFS, which has gained increased importance over the past three decades (Athukorala et al., 2002; Kohpaiboon, 2006). We also focus on some key specific processed food products that are the key export products of TPFS: processed shrimp,

processed chicken, canned pineapple and canned tuna. The processed food products used in this study are covered by the Harmonised System Codes 2002 (HS Code 2002) (see Appendix A). Although the HS code is regularly updated (e.g., HS 2007 and HS 2012), the newer versions of the HS code are not suitable for this study. This is because of the chosen study period, 1998-2016. The study uses the 2002 version.

The next feature relates to the trading partners. Previous research has identified differences in trade patterns (i.e., South to South and South to North) and suggested that each market is sensitive to different factors (Wilson et al., 2005). For example, developed countries (north markets) are more concerned about product quality and food safety issues than developing countries (south markets) (Baylis et al., 2010; Hallak, 2006). Thus, country characteristics (developed versus developing) should be considered when analysing the impact of economic and social upgrading on TPFEs. Therefore, we separate Thailand's processed food export trading partners into three subgroups: all countries, developed countries and developing countries. The lists of the countries classified by the United Nations are in Appendix B.

The last feature relates to the insignificant export value problem. To avoid misleading interpretations, a cut-off point was used to eliminate insignificant export values. This is because miscellaneous export values tend to represent temporary exports or error coding on the trade database. Thus, any export value lower than the cut-off point is eliminated (Jongwattanakul, 2012; Tanrattanaphong, 2012). Previous research noted that there is no concrete evidence indicating what the most appropriate cut-off is. The point depends on many factors, including the type of product, different academic perspectives and sensitivity tests (Jongwanich, 2009; Jongwattanakul, 2012; Tanrattanaphong, 2012). The cut-off point used in this study is 0.5 per cent of the average export value of processed food products during 1998-2016. To test the sensitivity of the cut-off point, we simulated various cut-off points from 0.1 to 1 per cent. The results show that the 0.5% cut off point is appropriate. This point covers most export values for each product (about 90%). The values on either side of this point (higher or lower) vary slightly in terms of the number of trading partners and export value of each product (for details, see Appendix D).

Equation (4.3) analyses the impact of economic and social upgrading on TPFEs with different groups of trading partners. For a time fixed effect, our study included the global financial crisis variable in equation (4.3). The variable captures the time effect arising from the Asian financial crisis and 2008 global financial crisis between 1998 and 2016.

$$\begin{aligned}\ln EX_{THj,t} = {} & \beta_o + \beta_1 \ln GDP_{TH,t} + \beta_2 \ln GDP_{j,t} + \beta_3 \ln DIS_{THj} + \beta_4 \ln PCGDP_{TH,t} + \beta_5 \ln PCGDP_{TH,t} \\ & + \beta_6 \ln POP_{TH,t} + \beta_7 \ln POP_{j,t} + \beta_8 BORDER_{THj} + \beta_9 TAGREE_{THj,t} + \beta_{10} ASCRISIS_t \\ & + \beta_{11} GFCRISIS_t + \beta_{12} \ln RER_{THj,t} + \beta_{13} PRODUCTUP_{TH,t} + \beta_{14} \ln PROCESSUP_{TH,t} \\ & + \beta_{15} \ln PROCESSUP_{TH,t-1} + \beta_{16} \ln FUNCUP_{TH,t} + \beta_{17} \ln FUNCUP_{TH,t-1} \\ & + \beta_{18} SOCUP_{TH,t} + \alpha_j + \varepsilon_{ijt} \end{aligned} \quad (4.3)$$

The dependent variable, a processed food export value, is separated into five product categories. These categories are: total processed food, processed shrimp, processed chicken, canned tuna and canned pineapple. The subscript j refers to the trading partners gfor these five categories. We separate trading partners into three groups: all countries, developed countries, and developing countries. Table 4-1 defines the model variables.

Table 4-1 Definitions of the Variables used in Equation (4.3)

Variable	Definition
$\ln EX_{THj,t}$	Export value of the Thai processed food products to country j at time t
$\ln GDP_{TH,t}$	Real GDP of Thailand at time t
$\ln GDP_{j,t}$	Real GDP of country j at time t
$\ln DIS_{THj}$	Geographic distance between Thailand and country j
$\ln PCGDP_{TH,t}$	Real GDP per capita of Thailand at time t
$\ln PCGDP_{j,t}$	Real GDP per capita of country j at time t
$\ln POP_{TH,t}$	Population of Thailand at time t
$\ln POP_{j,t}$	Population of country j at time t
$BORDER_{THj}$	Dummy variable of common border between Thailand and country j: 1 = shared border, 0 = otherwise
$TAGREE_{THj,t}$	Dummy variable of trade agreements between Thailand and country j at time t: 1 = having trade agreements, 0 = otherwise
$ASCRISIS_t$	Dummy variable: 1 = Asian financial crisis at time t , 0 = otherwise
$GFCRISIS_t$	Dummy variable: 1 = 2008 global financial crisis at time t , 0 = otherwise
$\ln RER_{THj,t}$	Real exchange rate index between Thailand and country j at time t
$PRODUCTUP_{TH,t}$	Product upgrading of TPFS at time t
$\ln PROCESSUP_{TH,t}$	Process upgrading of TPFS at time t
$\ln PROCESSUP_{TH,t-1}$	Process upgrading of TPFS at time t-1
$\ln FUNCUP_{TH,t}$	Functional upgrading of TPFS at time t
$\ln FUNCUP_{TH,t-1}$	Functional upgrading of TPFS at time t-1
$SOCUP_{TH,t}$	Social upgrading of TPFS at time t
α_j	The importer fixed effect
ε_{ijt}	The disturbance term

Source :Developed by the author

4.2.2 Variable Measurement and Data

The study period 1998-2016 was chosen because there was increased importance of the GVCs approach to global trade. In addition, the study period covers the adoption of food safety standards (such as SPS). These standards have had a significant impact on traded processed food. The last reason relates to data availability. Before 1998, there are limited data. Thai processed food export values have been completely reported only since 1998 via the important trade database, UN Comtrade and the Global Trade Atlas.

Thai processed food bilateral trade (dependent variable) data are from the Global Trade Atlas and the UN Comtrade database in millions of U.S. dollars (annual export value). The data for the independent variables shown in equation (4.3), both for Thailand and its trading partners' GDP, GDP per capita, population and geographic distance are from the World Development Indicators and the CEPII

database (Baylis et al., 2010; Choi, 2013; Saslavsky & Shepherd, 2014). The export value of processed food products, GDP and GDP per capita are calculated in real terms. The common border, trade agreement and financial crises are included as dummy variables. The common border is equal to one if Thailand shares a border with the trading partner, zero otherwise. With respect to trade agreements, the study uses the FTAs between Thailand and its trading partners as a proxy for this variable. It equals one if an FTA has been completely promulgated between Thailand and the trading partner, zero otherwise. Financial crisis is another dummy variable; it equals one if a financial crisis occurs in year t, zero otherwise. There are two important financial crises in the model: the Asian financial crisis and the 2008 global financial crisis. This study does not examine the impact of the euro crisis. This is because the euro crisis did not have a major effect on TPFEs. The real exchange rates are calculated from the bilateral exchange rates between Thailand and its trading partners multiplied by the ratio of average prices of trading partners to average prices of Thailand (Jongwanich, 2009; Jongwattanakul, 2012). The measurement of economic and social upgrading variables is outlined below.

4.2.2.1 Product Upgrading

We apply Bernhardt and Milberg's (2011a) composite index, which has been used in several empirical studies, to estimate product upgrading of TPFS (Bernhardt, 2013; Lee & Gereffi, 2013, Salido & Bellhouse, 2016). This index is built from an equally weighted combination of changes in market share and product price. Bernhardt and Milberg (2011a) use the equally weighted effects of the two indicators since the literature has not been able to provide exact, definite impacts of the two indicators on the computation of the product upgrading index. A good start to the computation is to use the equally weighted effect, rather than an unequally weighted effect. Bernhardt and Milberg (2011a) tested the consistency of the result of the product upgrading measure using the equally weighted method. After changing some criteria in the computation, they find that the result of the product upgrading measure using the equally weighted factors is consistent with other methods.

If the index value is positive, it means that product upgrading has occurred. However, if it is negative, then downgrading has occurred. The formula for the composite index is equation (4.4):

$$\text{Product upgrading/downgrading} = 0.5*(\%\Delta\text{Market share}) + 0.5*(\%\Delta\text{Export unite value}) \quad (4.4)$$

The study uses the composite index to evaluate product upgrading in TPFS at time t. The formula for product upgrading is given in equation (4.5):

$$\text{Product upgrading/downgrading} = 0.5*(\%\Delta MS_{j,t}) + 0.5*(\%\Delta EUV_{j,t}) \quad (4.5)$$

where $\%\Delta MS_{j,t}$ indicates the percentage change in the market share of Thai processed food in the world market at year t, $\%\Delta EUV_{j,t}$ indicates the percentage change in the export unit value of Thai processed

food in the world market at year t. The export unit value is calculated using export volume divided by export quantities (Bernhardt, 2013; Salido & Bellhouse, 2016).

4.2.2.2 Process Upgrading

Process upgrading occurs when a country transforms inputs into outputs more efficiently, such as meeting various product standards related to food safety. To meet these standards, countries must improve their production processes (Ponte & Ewert, 2009). If countries fail to meet the standards, trading partners will refuse to buy the product. This study uses the export value per number of import refusals ratio as a proxy for process upgrading. This is because, if countries improve their production processes, export value per the number of import refusals will increase (Baylis et al., 2010; Jongwanich, 2009; Jouanjean, 2012). This study uses import refusals data from two sources: The US Food and Drug Administration (FDA) for the U.S. and the Rapid Alert System for Food and Feed (RASFF) for the EU (Baylis et al., 2010; Jongwanich, 2009; Jouanjean, 2012).

4.2.2.3 Functional Upgrading

Functional upgrading refers to the process of achieving new functions in GVCs, such as moving from assembly actors to distributors (Gereffi, 1999; Haakonsson, 2009; Pananond, 2012). Although there is no standard measurement to evaluate functional upgrading, some scholars suggest that increasing OFDI can reflect functional upgrading. In short, moving from a domestic producer to an overseas distributor often requires increased OFDI in the overseas country (Navas-Aleman, 2011; Pananond, 2012; Ponte & Ewert, 2009). Thus, we use the OFDI values of the Thai food production sector as a proxy for functional upgrading in the Thai processed food industry. The OFDI values are from the Bank of Thailand.

4.2.2.4 Social Upgrading

Compared with other forms of upgrading, social upgrading has received little scholarly attention. There is no standard measurement to assess social upgrading. Bernhardt and Milberg (2011a) provide a composite index to evaluate social upgrading. This index has been widely acknowledged by researchers (Bernhardt, 2013; Lee & Gereffi, 2013, Salido & Bellhouse, 2016). The social upgrading index is computed from the equally weighted combination of changes in employment rate and real wages. Equally weighted effects of the two indicators are used since research has not been able to provide the exact, definite impacts of the two indicators on the computation of the social upgrading index. Therefore, a good start for the computation is to use the equally weighted effects rather than unequally weighted effects (Bernhardt & Milberg, 2011a).

A positive index means that social upgrading has occurred and a negative index, the reverse. The social upgrading index is given in equation (4.6):

$$\text{Social upgrading/downgrading} = 0.5*(\%\Delta\text{Employment}) + 0.5*(\%\Delta\text{Real wage}) \quad (4.6)$$

This study uses the composite index to investigate social upgrading in TPFS at year t. The formula for social upgrading index is in equation (4.7):

$$\text{Social upgrading/downgrading} = 0.5*(\%\Delta EMP_t) + 0.5*(\%\Delta RW_t) \quad (4.7)$$

where $\%\Delta EMP_t$ is the percentage change in employment in the Thai processed food industry at year t, $\%\Delta RW_t$ is the percentage change in real wages in the Thai processed food industry at year t. Employment and wage dataof the Thai processed food industry are from the National Statistical Office.

4.2.3 Estimation Procedures

We first use standard panel data estimations (FEM and REM). The FEM intercept term may differ among trading partners that may have specific trade characteristics. There is also a relationship between the intercept term and independent variables in the FEM (Gujarati & Porter, 2005). FEM cannot accommodate time-invariant variables such as the geographic distance between Thailand and its trading partners (Cameron & Trivedi, 2009). The REM, in contrast, has different properties in terms of the intercept term. The REM intercept is calculated using large observations (with random drawing). This intercept has a constant mean value in contrast to the FEM intercept. Another key property of the REM intercept is that it is uncorrelated with other independent variables. Moreover, the REM can accommodate time-invariant variables (Baltagi, 2001; Gujarati & Porter, 2005). Standard panel estimations (FEM and REM) are used to regress equation (4.3).

The literature raises concerns about the use of the log-linear form of the gravity equation. The first problem relates to biased estimators, because of the Jensen's inequality problem. The second is heteroscedasticity. Another problem is the log-linearised estimation cannot deal with a zero export values that are found in export data (Jongwattanakul, 2012; Santos Silva & Tenreyro, 2006; Wood et al., 2017). These problems can lead to biased, inefficient estimates (Santos Silva & Tenreyro, 2006).

Some scholars suggest that applying the PML estimation with the Poisson family, namely PPML, can deal with Jensen's inequality, heteroscedasticity, and zero export values. The main difference between applying the PML estimation and Fixed and Random Effects approaches with the gravity model is that the gravity model dependent variable, when using PML estimation, is a trade value (a level) not a logarithm. According to Santos Silva and Tenreyro's (2006), Santos Silva and Tenreyro's (2011) and Staub and Winkelmann's (2011) studies, PPML estimation provides superior results to other

techniques (e.g., NLS, GPML, NBPML, ZIPML and ZINBPML) when dealing with the gravity model and the presence of heteroscedasticity, and the prevalence of zeros in trade data. The literature suggests that ZIPML and ZINBPML have limitations, in particular, the use of panel data and common statistical software (namely STATA) (Allison, 2011; Cameron & Trivedi, 2009; StataCorp LLC., 2017).

We therefore use the PPML estimation, applied with random and fixed effects (PPML-RE and PPML-FE) as the main instrument in our empirical model. We also use NBPML with random and fixed effects (NBPML-RE and NBPML-FE) to provide robust results. The zero-inflated model is not used in this study because of its limitations with panel data. As a result, equation (4.3) is transformed into equation (4.8) so that PPML and NBPML can be used. One important change is the dependent variable (export value) is reported at a level instead of a logarithm.

$$\begin{aligned} EX_{THj,t} = {} & \beta_o + \beta_1 lnGDP_{TH,t} + \beta_2 lnGDP_{j,t} + \beta_3 lnDIS_{THj} + \beta_4 lnPCGDP_{TH,t} + \beta_5 lnPCGDP_{TH,t} \\ & + \beta_6 lnPOP_{TH,t} + \beta_7 lnPOP_{j,t} + \beta_8 BORDER_{THj} + \beta_9 TAGREE_{THj,t} + \beta_{10} ASCRISIS_t \\ & + \beta_{11} GFCRISIS_t + \beta_{12} lnRER_{THj,t} + \beta_{13} PRODUCTUP_{TH,t} + \beta_{14} lnPROCESSUP_{TH,t} \\ & + \beta_{15} lnPROCESSUP_{TH,t-1} + \beta_{16} lnFUNCUP_{TH,t} + \beta_{17} lnFUNCUP_{TH,t-1} \\ & + \beta_{18} SOCUP_{TH,t} + \alpha_j + \varepsilon_{ijt} \end{aligned} \quad (4.8)$$

4.3 Determinants Influencing Economic and Social Upgrading: Literature Review

4.3.1 Relevant Variables

Research and development, (R&D) related to productive capacity is commonly used as a proxy to investigate the effect on economic and social upgrading and other relevant variables. The R&D variable is presented in many forms, such as R&D expenditure, R&D per capita and as a dummy variable (Harris & Moffat, 2011; Sandu & Ciocanel, 2014). For example, Bogliacino et al. (2012) and Cintio et al. (2017) find a positive relationship between R&D expenditure and employment rate (a proxy for social upgrading) at the firm and country levels, especially in the services and high-tech manufacturing sectors. Chen and Yang (2013) investigated the impact of R&D expenditure on OFDI (a proxy for functional upgrading) at the firm level in Taiwan. They argue that there is a positive relationship between R&D and OFDI. This means that an increase in R&D expenditure leads to OFDI expansion. Sandu and Ciocanel (2014) indicate that both the government and private firms' R&D expenditure leads to an increase in European countries' medium and high-tech product exports. Ge et al. (2015) argue that an increase in R&D expenditure can lead to a shift in Chinese export products' prices (as discussed above, export product price is a component used to calculate product upgrading). Scholars have acknowledged that human capital development results in increasing trade flow and economic and social upgrading. For instance, Miroudot and Ragoussis (2009) argue that professional

development stimulates export growth in the primary, manufacturing and service sectors. Mahutga (2014) elaborates that human development can encourage the value added to manufactured products. Sahu (2016) acknowledges that HRD is important in increasing the value of Malaysian exports. This is important since skills training and educational development are significant in developing nations for participation in and upgrading their position in GVCs. Upgrading to higher positions in GVCs (such as packaging and processing) requires skilled-workers (Bamber et al., 2014; OECD et al., 2014). Consequently, R&D expenditure and HRD are widely acknowledged as key determinants that support economic and social upgrading, including export growth.

There is a lack of research that investigates the impact of infrastructure and services factors on economic and social upgrading. Previous studies focused only on the relationship between those factors and trade flow. There are two broad groups of study. The first group examines the impact of infrastructure and services on trade flow and other relevant variables using infrastructure and service aggregate indices. Those indices are calculated by various methods, such as Principal Component Analysis and basic averages as seen in Francois and Manchin (2013) and Wilson et al. (2005). Empirical research also uses specific indices, such as LPI, as a representative of infrastructure development. However, the main drawback of the LPI index is a lack of data in some countries, especially developing countries. In addition, LPI data are not reported annually. This index is constructed only every two years (Athukorala, 2012; Saslavsky & Shepherd, 2014).

Martinez-Zarzoso and Nowak-Lehmann (2003) calculate the aggregate index of infrastructure and service using road and rail distance and telephone main lines per person. They investigated the impact of the aggregated index on countries' exports (European countries, Argentina, Brazil, Paraguay, Uruguay, and Chile). They find that infrastructure and service development have a positive impact on exports. Wilson et al. (2005) calculate the infrastructure aggregate index using port facilities and air transport indices. They employ indices of speed and cost of internet access and these factors effect on business to calculate an index of the service sector. Wilson et al. (2005) show that infrastructure and services positively impact exports. Portugal-Perez and Wilson (2012) support Martinez-Zarzoso and Nowak-Lehmann's (2003) and Wilson et al.'s (2005) results that physical and service infrastructure have positive impacts on exports. Athukorala (2012) and Saslavsky and Shepherd (2014) use LPI as a proxy for infrastructure development and investigate its impact on trade flow. These studies suggest that infrastructure and service development are significant for import and export expansion. In contrast, Portugal-Perez and Wilson's (2012) findings state that only physical infrastructure development (e.g., ports, railroads, roads, and airports) has a positive impact on exports, with respect to developing countries.

The second group focuses on individual infrastructure indices. These depend on data availability. For example, Wilson et al. (2003) use port efficiency and service sector indices as proxies for infrastructure. They investigate the impact of those indices on exports and argue that port efficiency and service sector development positively impact exports. Nordås' (2008), Shepherd and Wilson's (2009) and Ghafoor et al.'s (2013) results support Wilson et al.'s (2003) findings that infrastructure and the service sector are important for import and export growth. Nordås (2008) investigates the impact of variables related to infrastructure and the service sector, such as road/rail/air density and port efficiency, on exports. Shepherd and Wilson (2009) use the air infrastructure quality index to represent the infrastructure and service sectors and examined its impact on South East Asian countries' imports. Ghafoor et al. (2013) apply the all-weather roads index as a proxy for infrastructure and find that it positively impacts Pakistan's mango exports.

Some scholars argue that infrastructure and service development only have a minor impact on trade. For example, Clarke and Wallsten (2006), who employ the number of internet users as a proxy for infrastructure and service development, indicate that the number of internet users is insignificant for exports, especially developing countries' exports. Bojnec and Fertö's (2009) findings support Clarke and Wallsten's (2006) results. Bojnec and Fertö argue that the number of internet users has a minor impact on OECD countries' exports. In short, infrastructure development on trade flow has a positive impact ony for physical infrastructure (roads, ports, airports and rail).

Previous studies have examined the relationship between the business environment and trade flow, including economic development. Portugal-Perez and Wilson (2012) constructed a business environment aggregate index and examined its effect on exports. Their findings suggest that a good business environment has a positive impact on developing countries' export growth. Empirical research has also investigated the impact of other variables related to the business environment on trade flow (such as corruption, political stability, regulations and customs environment, access to credit and macroeconomic stability). Previous studies have used corruption indices as a proxy for a country's business environment. These indices are control of corruption and corruption perception indices. The higher the index, the lower the corruption level (Jong & Bogmans, 2011; Musila & Sigue, 2010). Wilson et al. (2005) use the corruption control and government policy transparency indices as a proxy for the business environment. Their findings show that lower corruption levels and greater government transparency lead to export growth. Nordås' (2008) and Horsewood and Voicu's (2012) findings support Wilson et al.'s (2005) results that good control of corruption enhances countries' export growth. Feng (2001) argues that poor political stability results in reduced private investment, especially in less developed countries. Busse and Hefeker's (2011) and Buchanan et al.'s (2012) results support Feng's (2001) findings that if a country has good political stability, there will be increased private investment. Increasing private investment is reflected in an increase in FDI into a country.

The positive relationship between private investment and political stability is usually found in empirical research, but the negative correlation between political stability and OFDI (a proxy for functional upgrading) seems to occur. That is, countries' political stability persuades investors to invest domestically, rather than invest overseas. Kayam (2009) examines the relationship between political stability and OFDI, with respect to developing and transitional countries. Kayam finds that when countries' political stability is improved, OFDI decreases, especially in emerging/developing countries. Klimek's (2015) results support Kayam's (2009) findings. Klimek (2015) explores political stability and government effectiveness indices on OFDI to find that OFDI tends to increase if a country fails to meet political stability. Some studies focus on the impact of macroeconomic stability on trade flow, specifically exchange rate volatility and price stability. These studies argue that countries that have macroeconomic stability can expand their exports (Jongwanich & Magtibay-Ramos, 2009; Tang, 2005). Other studies investigated the impact of better access to credit or financial development on economic and social upgrading and exports. For example, Jongwanich (2009) used a variable related to access to credit (the ratio of private credit to GDP) as an empirical model's regressors. Jongwanich's (2009) results indicate that better access to credit results in expansion of developing countries' processed food exports. Manova (2013) and Fosu and Abass (2019) acknowledges that financial development enhances countries' export diversification, especially developing countries. This is because increased financial support creates new export opportunities for developing countries. Lin's (2017) findings indicate that greater access to credit leads to Chinese enterprises' export growth.

However, some scholars note that financial development sometimes has no impact on economic and social upgrading, including export performance. For example, Pagano and Pica (2010) suggest that financial development leads to job reallocation. However, financial development has a positive impact only on sectors that have great profitability. This is because financial development attracts investors to invest in sectors that provide high benefits. As a result, only the employment rates of such sectors tend to be higher, not other sectors of an economy. Jerzmanowski and Nabar (2013), who explore the relationship between financial development and employment and wages, argue that financial development enhances only the wages of skilled labours, not low-skilled labourers.

Trade and investment policy is another key determinant that influences upgrading and participation in GVCs. Empirical studies use the trade openness index, or trade policy regimes, to explain trade flow and variables related to economic and social upgrading processes. The trade openness index is commonly calculated by export and import' summation divided by the GDP (Gul & Yasin, 2011; Jongwanich, 2009; Mahutga, 2014). Jongwanich's (2009), Gul and Yasin's (2011) and Mahutga's (2014) findings acknowledge that the trade openness index is positively significant for trade flow expansion, both to developed and developing countries. Ali (2017) suggests that the trade openness index enhances countries' export diversification. In short, a country that has a higher trade openness index

can diversify its exports to new destinations or new partners in world markets. Tejani and Milber (2016), who apply the ratio of exports to GDP as a proxy for trade policy regime, contend that greater reliance on international trade increases female-employment in developing countries. Majid (2004) suggests that trade openness has a positive impact on social upgrading only in the long-term. In the short-term, there is a negative correlation between social upgrading and trade openness. This is because an increase in international trade leads to wage adjustments (lower wages) within countries initially. Countries gain some advantage from local lower wages in world markets.

Other scholars examine variables related to trade liberalisation, such as preferential trade agreements (PTAs) and FTAs, to explain trade flow and upgrading (Casacuberta et al., 2004; Pacheco-López, 2005). Casacuberta et al. (2004) use average tariff rates as a proxy for trade liberalisation and find that trade liberalisation's impact on employment growth is minor in Uruguay. Using a dummy variable to represent trade liberalisation, Pacheco-López (2005) argues that the relationship between trade liberalisation and Mexico's trade flow is positive. As a result of PTAs' and FTAs' importance in trade policy in international trade, several studies have focused on trade agreements' role in trade flows. Those studies report both positive and negative correlations between trade agreements and trade flows. For example, Brooks and Ferrarini (2012) contend that trade agreements have a positive impact on trade flows in both developed and developing nations. By contrast, Akhter and Ghani (2010) and Jongwattanakul (2012) suggest that trade agreements have both a positive impact and no impact on trade flows. In particular, trade agreements do not stimulate export growth in the agricultural sector in developing countries. Philippidis et al. (2014) show that trade agreements have both positive and negative impacts on trade flows. The negative relationship between trade agreements and trade flows is particularly evident in agricultural exports. This is because, when tariff measures are exempt, non-tariff measures (e.g., the RoO and food safety standards) become increasingly important in global trade. Sometimes, non-tariff measures become trade barriers, rather than trade enhancements.

In summary, the key determinants affecting participation in GVCs and the occurrence of economic and social upgrading are generally covered by five determinants: productive capacity, infrastructure and services, business environment, trade and investment policies and industry institutionalisation. In quantitative analysis, most previous research uses variables related to these five determinants (including variables related to economic and social upgrading) to explain the relationship between them and trade flows.[21] However, there are limitations in the prior research. There is a lack of empirical studies that focus on the effect of the five determinants on economic and social upgrading. In addition, although some qualitative research contends that the five determinants positively affect economic and social upgrading (Bamber et al., 2014; Kowalski et al., 2015; OECD et al., 2014), some empirical studies

[21] See the Table E-1 for the summarisation of the literature review in Appendix E.

find that the effects are both positive and negative. Finally, there is a notable lack of empirical research that investigates industry institutionalisation's impact on economic and social upgrading.

4.3.2 Choice of Estimators

Previous empirical research that has examined the five determinants' impacts on economic and social upgrading and trade flows has used various econometric methods. Those methods depend on the characteristics of the data, which can be divided into cross-sectional, time series and panel data. OLS estimation is often used for cross-sectional data (Lin, 2017; Nordås, 2008; Sahu, 2016). For time-series data, scholars often use techniques such as the error correction model, co-integration and causality analysis to test the relationship between the five determinants and exports in both the short and long term (Ghafoor et al., 2013; Pacheco-López, 2005). With panel data, some previous studies have used Pooled-OLS to estimate the impact of the five determinants on trade flows. For example, Shepherd and Wilson (2009) use Pooled-OLS to evaluate the impact of the infrastructure development (such as the quality of sea and air ports) and variables related to the business environment (for instance, irregular payments) on the import flows of ASEAN countries during 2000-2005. Akhter and Ghani (2010) used Pooled-OLS to estimate the impacts of variables related to trade and investment policy (FTAs) on trade flows of South Asian countries between 2003 and 2008. However, as discussed earlier, using Pooled-OLS to deal with panel data leads to biased estimates and misleading inferences because of heteroscedasticity (Gujarati & Porter, 2005). To avoid biased estimates, most empirical research uses FEM and REM to analyse panel data (Ge et al., 2015; Mahutga, 2014; Tejani & Milberg, 2016). Some studies are concerned with the occurrence of zero-value dependent variables, such as export value. They apply PPML, ZIPML, ZINBPML estimators to deal with this problem. These estimators tend to provide better results than other estimators (FEM and REM) (Jongwattanakul, 2012; Portugal-Perez & Wilson, 2012). In summary, there is no standard econometric method to deal with all different types of data. Instead, scholars must consider the data's characteristics to select the appropriate model.

4.4 Determinants Influencing the Upgrading of the Thai Processed Food Sector

4.4.1 Empirical Model

The empirical model used to investigate the five determinants' impact on economic and social upgrading of TPFS has some important features. The first feature is level of product analysis. We focus on Thailand's total processed food exports, not on specific processed food products (processed shrimp, processed chicken, canned tuna, and canned pineapple). This is because there are limited data for some variables, such as employment rate and wages for those specific products.

The second feature are the independent variables used in the empirical model. Variables associated with the five determinants need to be selected with caution since data availability is scarce or incomplete for some determinants. According to the literature and data availability, R&D (RD) and development in human capital (HD), which are acknowledged as a key mechanisms for upgrading and participation in processed food's GVCs, are used as proxies for productive capacity. Empirically, R&D is determined using the ratio of R&D expenditure to GDP. Human development is explained by educational achievement (Akcali & Sismanoglu, 2015; Sahu, 2016; Sandu & Ciocanel, 2014). We employ port performance (PORT) and access to the internet (INT) to proxy for infrastructure and service development. Previous studies indicate that port infrastructure is the most important infrastructure for the processed food sector's development (Francois & Manchin, 2013). We apply the political stability (PS) and the availability of financial support (FINSUP) variables as a proxy for the business environment. That is, an increase in political stability results in an increase in stakeholders' confidence in the export sector and supports a conducive business environment for international trade (Horsewood & Voicu, 2012; OECD et al., 2014). Adequate financial support leads to firms' development, such as the transport and storage of goods and improvements in production and distribution technologies. This type of development allows firms to reduce the risks and uncertainties of their participation in GVCs (Jongwanich, 2009). Trade policy regimes (i.e., trade openness) is used to represent the role of the trade and investment policy (Jongwanich, 2009; Mahutga, 2014). We use the trade openness (TOPEN) index to represent the trade policy regime. A higher index value implies that the country pays more attention to international trade. Finally, industry institutionalisation covers collaboration between the private and government sectors to create strategies or policies to support the development of the processed food industry (e.g., establishing laboratories to assess food safety). The presence of the Thai national laboratory is noted. This laboratory was built with funding from both the Thai government and private firms to help the agri-food sector reduce its costs in relation to investigating food safety standards. Before this laboratory was available, local firms in Thailand's agri-food sector sent their products overseas (especially to developed countries) to confirm product quality, a costly process (Central Laboratory (Thailand), 2016).

The third feature relates to the dependent variables of the empirical model. Economic (i.e., product, process, and functional upgrading) and social upgrading types are used as dependent variables in the model. The empirical model used to analyse the impact of the key determinants on economic and social upgrading of TPFS is given in equation (4.9):

$$UPGRADING_{i,t} = \beta_o + \beta_1 RD_t + \beta_2 HD_t + \beta_3 PORT_t + \beta_4 INT_t + \beta_5 PS_t + \beta_6 FINSUP_t + \beta_7 TOPEN_t + \beta_8 LAB_t + \varepsilon_t \quad (4.9)$$

where: subscript i refers to upgrading types: economic (product, process, functional) and social upgrading. The definitions of the model variables are provided in Table 4-2.

Table 4-2 Definitions of the Variables used in Equation (4.9)

Variable	Definition
$UPGRADING_{i,t}$	Type i of upgrading of TPFS at time t
RD_t	R&D expenditure per GDP of Thailand at time t, represented by productive capacity
HD_t	Human development of Thailand at time t, represented by productive capacity
$PORT_t$	Port performance of Thailand at time t, represented by infrastructure and service
INT_t	Access to the internet of Thailand at time t, represented by infrastructure and service
PS_t	Political stability index of Thailand at time t, represented by business environment
$FINSUP_t$	Access to financial support of Thailand at time t, represented by business environment
$TOPEN_t$	Trade openness index of Thailand at time t, represented by trade policy
LAB_t	Presence of creditable laboratories in Thailand at time t, by represented industry institutionalisation
ε_t	The disturbance term

Source: Developed by the author

4.4.2 Variable Measurements and Data

Data for analysing the determinants' impacts on the TPFS' economic and social upgrading are annual from 1998 to 2016 because of data availability. According to equation (4.9), the dependent variable refers to upgrading types: economic (product, process and functional) and social upgrading.

Based on the independent variables in equation (4.9), the R&D variable (RD) is generated in the form of R&D expenditure to the Thai GDP ratio. This variable is extracted from the World Development Indicators and the National Science Technology and Innovation Policy Office of Thailand. Human development (HD) is explained by enrolment in tertiary education (% gross) extracted from World Development Indicators. Port performance (PORT) is measured using container port traffic; this refers to the flow of containers (in 20-foot equivalent units) from land to sea transport modes, and vice versa. An increase in a number of containers implies that port infrastructure has improved. Access to the internet (INT) is computed using the number of individuals using the internet (percentage of Thailand's population). All of the variables related to infrastructure and service are extracted from World Development Indicators. Political stability (PS) is a proxy for the political environment. It captures perceptions of the likelihood of political instability and/or politically-motivated violence, including

terrorism. The estimate provides a score on the aggregate indicator, extracted from Worldwide Governance Indicators. A country's score is calculated using the standard normal distribution (i.e., it ranges from approximately -2.5 to 2.5). A higher index implies improved political stability. Availability of financial support (FINSUP) is computed from private credit to GDP. Both the PS and FINSUP variables are extracted from Global Financial Development and Worldwide Governance Indicators. Trade openness (TOPEN), which represents trade policy regime, is calculated using Thai export and import summation divided by Thai GDP. Finally, the industry institutionalisation variable is represented by the Thai Central Laboratory (LAB). A dummy variable is used here. It is equal to one between 2005 and 2016, otherwise zero. This is because the Thai Central Laboratory was established in 2005 (Central Laboratory (Thailand), 2016).

4.4.3 Econometric Procedure

The dataset used to estimate equation (4.9) includes annual data from 1998 to 2016. However, there are some limitations, particularly in relation to the short data period. Thus, we use OLS estimation to examine the relationship between the upgrading variable and the independent variable given in equation (4.9). Although OLS estimation can deal with equation (4.9), the short period of data can lead to biased estimates (Gujarati & Porter, 2005).

To overcome this constraint, we apply the frequency conversion technique to covert annual data into quarterly data to expand the dataset. This technique is widely applied when using a short data period or when there is a lack of available information. Macroeconomic data are often reported annually, especially for developing countries (Chan, 1993; Lisman & Sandee, 1964; Rashid & Jehan, 2013). In addition, when focusing on a specific case (i.e., a specific country), limited data are inevitable. A number of scholars discuss various methods that can be used to convert annual data into quarterly data (Chan, 1993; Chow & Lin, 1971; Denton, 1971; Lisman & Sandee, 1964; Litterman, 1983). The literature identifies two main different procedures for converting annual data into quarterly figures. In the first procedure, low-frequency data (e.g., annual data) must be converted into high-frequency data (i.e., quarterly data) by using other observed and relevant high-frequency data as predictors (Chow & Lin, 1971; Denton, 1971; Litterman, 1983). Rashid and Jehan (2013) converted Pakistan's annual GDP to quarterly figures using the consumer price index and the industrial production index as predictors. In another example, Ajao et al. (2015) used quarterly exports and imports as predictors to disaggregate Nigeria's annual GDP into quarterly GDP.

The second procedure relates to annual data interpolation, which relies on univariate methods (Chan, 1993; Lisman & Sandee, 1964; Rashid & Jehan, 2013). Lisman and Sandee (1964) state that if there are no assumptions in the conversion of annual data into quarterly data, a simple method can be used. There are many simple interpolation methods that can be used in various statistics software packages

(e.g., Eviews). They include constant, linear, quadratic, and cubic methods. Briefly, the constant method, which is separated two sub-methods (constant-sum and constant average), assigns the same value for all observations in the high-frequency series that correspond to the specific low-frequency series. The linear method consists of two sub-methods: linear-first and linear-last. This method assigns each observation in the low-frequency data to the first or last high-frequency observation, associated with the low-frequency series, then places all intermediate points on straight lines connecting the points. The quadratic method fits a local quadratic polynomial for each value of the low-frequency data. The polynomial form places all observations in the high-frequency series in relation to either the average or the sum of the high-frequency points so that it matches the low-frequency data actually observed. The last method, the cubic method, determines each value in the low-frequency series in relation to the first or last high-frequency observation, corresponding to the low-frequency period. After that, it places all intermediate points on a natural cubic spline connecting all of the points (Griffiths et al., 2012; IHS Global Inc., 2014, 2017).

As has been noted in previous research, since there are no assumptions relating to the study's variables in equation (4.9), then the simple interpolation methods can be used. Consequently, we employ constant, linear, quadratic, and cubic methods to disaggregate the annual data in equation (4.9) into quarterly results. Following these conversions, the log-normal form is applied with equation (4.9) to adjust the data's smoothness. According to equation (4.9), product upgrading, social upgrading, political stability, and the presence of credible laboratories are not in the form of the logarithm. The first three variables contain both positive and negative values. The last variable is a dummy variable. OLS estimation is used to estimate equation (4.9). Next, the goodness of fit measurement is empirically estimated using the Root Mean Square Error (RMSE) and R-square (Abeysinghe & Lee, 1998; Abeysinghe & Rajaguru, 2004; Ajao et al., 2015; Chan, 1993; Friedman, 1962).

4.5 Chapter Summary

This chapter presents the empirical models and methodology to answer two research objectives: (1.) to examine the impact of economic and social upgrading on TPFEs; and (2.) to identify the key determinants that influence economic and social upgrading for TPFS. For the first objective, we use the augmented gravity model regressed by PPML-FE and PPML-RE estimation to address the upgrading impacts on TPFEs with panel data from 1998-2016. We also use alternative estimation techniques, NBPML and FEM and REM, to regress the augemented gravity model to provide robust findindgs. To address the second objective, we use OLS to estimate our empirical model. The dataset for the second objective includes annual data for 1998 to 2016. However, this short period of data is one key constraint in the second objective. As a result, frequency conversion technique converts annual data into quarterly data to expand the dataset before estimating the empirical model by OLS.

Chapter 5

Empirical Results and Discussion

This chapter presents the empirical results and discussion. The chapter is divided into five sections. Section 5.1 reports the results of the impacts of economic and social upgrading on TPFEs. Section 5.2 discusses the upgrading impacts on TPFEs. Sections 5.3 and 5.4 provide the results about the key determinants influencing the economic and social upgrading of TPFS and discusses the findings. Section 5.5 summarises the chapter.

5.1 Economic and Social Upgrading Impacts on Thai Processed Food Exports

Tables 5-1 to 5-16 present the economic and social upgrading impacts on TPFEs. The results are divided into five sub-sections based on product category. The categories are: total processed food, processed shrimp, processed chicken, canned tuna and canned pineapple. These results are estimated using various econometric techniques, such as PPML[22], NBPML, FEM and REM. However, we focus on the results obtained by the PPML method for discussion and interpretation. This is because previous scholars have suggested that the PPML technique provides superior estimates with the gravity model (Santos Silva & Tenreyro, 2006, 2011; Staub & Winkelmann, 2011). The results estimated by the NBPML, FEM and REM methods are to check the robustness of the PPML estimates.

5.1.1 Total Processed Food Exports

Tables 5-1 to 5-3 show the impact of economic and social upgrading on total processed food exports to different groups of trading partners. These groups are: all countries, developed countries, and developing countries. The outcomes estimated by PPML-RE and PPML-FE show that most upgrading types are positively related to total processed food exports to all countries (see Table 5-1). Product upgrading is positively significant for the exports at the 0.05 level. Interestingly, the process upgrading (lagged) variable has a negative (positive) impact on the exports at the 0.1 (0.05) level. That is, producers/exporters need to invest a lot of time, research and capital to meet product standards. This can lead to increased production costs and, subsequently, to reduced export competitiveness and export volumes in global markets (Baylis et al., 2010; Jeffee & Henson, 2004; Ponte, 2002). As a result, process upgrading is likely to have a negative impact on the exports during the current period because

[22] It is important to note that the STATA programme allows random and fixed effects to be applied to the Xβ term in the model when using PPML estimations, like standard panel estimations. PPML-FE or FEM estimates cannot report the coefficient result of time invariant variables. In contrast, when using NBPML, the STATA only allows random and fixed effects to be applied to the distribution of the dispersion parameter, not to the Xβ term in the model (Alison, 2011; StataCorp LLC, 2017). Thus, NBPML estimations (applied to the fixed effect) can report the coefficient result of time invariant variables.

of a shift in production costs and a subsequent decrease in export competitiveness. On the other hand, the process upgrading lagged variable positively impacts the exports, which indicates that producers/exporters learn how to achieve product standards, which inevitably leads to increased in export volume. The functional and social upgrading variables have positive impacts on the exports at the 0.05 level.

Interestingly, we found mixed results between the total processed food exports to developed and developing countries. That is, PPML estimates show that all upgrading types are still statistically, positively significant for total processed food exports to developed countries with differences in significance levels. For example, the product upgrading variable is positively significant for total processed food exports to developed countries at the 0.1 and 0.05 levels, estimated by PPML-RE and PPML-FE, respectively. The process upgrading lagged variable has a positive impact on the exports at the 0.05 level. The functional upgrading variable and the functional upgrading lagged variable are positively significant at the 0.01 and 0.05 levels, respectively. Likewise, the social upgrading variable is positive significant for the exports at the 0.01 leve (see Table 5-2). In contrast, the upgrading types are insignificant for exports to developing countries (see Table 5-3). This agrees with previous studies that suggest that product standards are usually more important for developed countries. To break into developed countries' markets, producers/exporters need to upgrade their production processes to meet those high standards. It seems developing countries pay less attention to such standards. Therefore, producers and exporters sometimes do not have to upgrade their production processes when their main export partners are from developing countries (Buzby, 2001; Dolan & Tewari, 2001; Lee & Gereffi, 2014; Ponte, 2002).

To ensure the robustness of the PPML estimates, most estimates from alternative methods (NBPML, REM and FEM) support the PPML estimates in relation to the upgrading impacts on total processed food exports. In particular, most estimates of NBPML, REM and FEM confirm that most upgrading variables are statistically significant for total processed food exports to developed countries at the 0.01 and 0.05 levels and insignificant for developing countries (see Tables 5-1 - 5-3).

With respect to the conventional variables (GDP and distance), PPML estimation gives mixed outcomes. Thai GDP is statistically insignificant in total processed food exports to all countries (see Table 5-1). With regard to exports to developed and developing countries, the results show that the Thai GDP variable is positively significant at the 0.05 level and insignificant for exports of total processed food to developed and developing countries, respectively (see Tables 5-2 and 5-3). Previous research noted that GDP can be an insignificant variable with the gravity model. This is because, when analysing a specific product and a particular market, exporting or importing values are slightly significant in terms of GDP (Gebrehiwet et al., 2007; Mulapruk & Coxhead, 2005). Hence, it is unlikely

that GDP will affect export expansion. The trading partners' GDP variable is positively significant for total processed food exports to developed countries at the 0.1 (0.05) level estimated by PPML-RE (PPML-FE), but is negatively significant for exports to all countries and developing countries at the 0.01 significance level (see Tables 5-1 - 5-3). Although the negative impact of GDP on the exports contradicts the concept of the gravity model, as some previous studies have explained, a GDP negative coefficient can occur. This is often occurs when a country's economy is small and relies heavily on trade (Alesina & Wacziarg, 1998; Mulapruk & Coxhead, 2005). During 1998-2016, Thailand tried to widen its export markets through exporting processed food to ASEAN countries whose GDPs were lower than those of traditional partners, such as the U.S. and Japan. Accordingly, it is not surprising that the result is a negative relationship between total Thai processed food exports and trading partners' GDP. Interestingly, the distance variable is statistically insignificant for exports of total processed food to developed countries. This may reflect food technology and logistic development impacts between Thailand and developed countries. The development encourages the maintenance of high product quality standards, which helps to reduce trade resistance caused by geographic distance (Athukorala et al., 2002).

To investigate the robustness of PPML estimates in relation to the impact of the conventional variables on exports, we use the NBPML-RE, NBPML-FE, REM, and FEM methods. We find that most estimation methods confirm the PPML estimates. For instance, NBPML, REM and FEM report that the Thai GDP variable is statistically insignificant for exports of total processed food to all countries and developing countries. The REM and FEM estimates suggest that the GDP trading partner variable is statistically, positively significant for these exports to developed countries at the 0.01 and 0.05 levels, respectively. All alternative estimates confirm that the distance variable is insignificant for total exports to developed countries (see Tables 5-1 - 5-3).

The PPML estimates indicate that Thailand's GDP per capita is not statistically significant in terms of total processed food exports to all countries. In contrast, a positive impact of trading partners' GDP per capita on exports to all countries is given by the PPML estimate at the 0.01 level (see Table 5-1). In addition, when focusing on total processed food exports to developed and developing countries, the PPML method provides mixed outcomes. That is, the variables of Thailand and trading partners' GDP per capita have negative impacts on total processed food exports to developed countries at the 0.1 and 0.05 levels, respectively (see Table 5-2). In contrast, the trading partners' GDP per capita has a positive impact only on exports to developing countries at the 0.01 level (see Table 5-3). This means that the total processed food exports to developed countries are classified as labour-intensive industries and the exports are necessity goods. This agrees with previous studies that most processed food exports to developed countries rely on local workforces and are usually "made-to-order"

products (Kohpaiboon, 2006; The Office of Industrial Economics, 2015). Processed food exports to developing countries are characterised as luxury goods.

The Thai population variable is dropped because of collinearity problems (Alison, 2011; Cameron & Trivedi, 2009). For the trading partners' population variable, PPML estimation suggests that an increase in a trading partner's population leads to a shift in total processed food exports to all countries. However, PPML estimation provides mixed results for the impact of the trading partner's population variable, when focusing on exports to developed and developing countries. The PPML-RE and PPML-FE estimates indicate that the trading partners' population variable has a negative impact on total processed food exports to developed countries at the 0.1 and 0.05 levels, respectively. That is, an increasing population denotes a larger resource endowment, larger domestic markets or self-sufficiency. This means that they tend to rely less on international trade (Oguledo & Macphee, 1994; Papazoglou, 2007). In contrast, the PPML estimate suggests a positive significant relationship with processed food exports to developing nations at the 0.01 level. This means that a trading partner's increasing population increases the market size and hence provides greater opportunities for TPFEs to developing-country markets.

The PPML estimate shows that the common border variable is insignificant for total processed food exports (see Tables 5-1 - 5-3). The result also suggests that the trade agreement variable is not significant for total processed food exports to all countries (see Table 5-1). This agrees with previous evidence that Thailand has had under-utilised trade agreement opportunities with trading partners during the past two decades (Kohpaiboon & Jongwanich, 2015; Phongpaichit & Baker, 2002). However, with respect to only total processed food exports to developing countries, the trade agreement variable is positively significant at the 0.05 level (see Table 5-3). This is because major trading partners within the group of developing countries are ASEAN countries (UN Comtrade, 2017). This is not surprising given that the Asian Economics Community agreement has been fully implemented (Department of Trade Negotiations, 2017). The PPML estimate shows that the 2008 global financial crisis was insignificant for exports of total processed food (see Tables 5-1 - 5-3). This is possible since the effect of the crisis was between the last quarter of 2008 and the first half of 2009. The crisis had significant negative impacts on the world economy. However, in the last quarter of 2009, the global economy recovered, and exports around the world began to increase. As a result, its impact seems to be marginal, especially when export data are reported as annual aggregated data (Jongwattanakul, 2012). The real exchange rate variable is negatively significant (at the 0.05 level) only for total processed food exports to developing countries (see Table 5-3). However, a positive result was expected. This is because a real exchange rate depreciation reflects a decrease in export product prices and, subsequently, an increase in export volume. There are important reasons supporting the negative sign of the real exchange rate coefficient. Thailand primarily exports processed food to ASEAN

countries where developing countries account for over 50% of total exports to developing nations. Intra-trade in ASEAN usually employs U.S. dollar and Thai bath as the trading currencies (Bank of Thailand, 2017). As a result, increased trade within ASEAN leads to appreciation of the Thai currency.

To ensure the robustness of the PPML estimates as discussed above, NBPML-RE, NBPML-FE, REM, and FEM methods were used. Most estimates support the PPML outcomes. For instance, all estimation methods reveal that the Thai GDP per capita variable is insignificant for exports of total processed food to all countries and developing countries (see Tables 5-1 and 5-3). The outcomes of REM and FEM support the PPML findings that the trade partner's population is negatively significant for exports of total processed food to developed countries. All methods confirm that the 2008 global financial crisis was insignificant for exports of total processed food to developing countries (see Tables 5-1 and 5-3). The REM and FEM outcomes indicate that the real exchange rate variable is insignificant in total processed food exports to developed countries, as found by the PPML method (see Table 5-2). This result also agrees with some previous studies that suggest that the exchange rate's positive impact on exports is only for low-income countries (Chaudhary et al., 2016; Fang & Miller, 2004; Haddad & Pancaro, 2010).

Table 5-1 Thailand's Total Processed Food Exports to all Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	9.758	9.757	-0.609	-1.158	2.358	263.245
	(7.143)	(7.188)	(10.697)	(11.387)	(5.419)	(447.436)
$\ln GDP_{j,t}$	-8.263***	-8.281***	6.246*	2.613	-1.312***	-0.752
	(2.177)	(2.191)	(3.632)	(4.303)	(0.445)	(0.485)
$\ln DIS_{THj}$	-1.713***	n.a.	-1.991***	-1.829***	-0.255	n.a.
	(0.648)		(0.158)	(0.165)	(0.221)	
$\ln PCGDP_{TH,t}$	-12.821	-12.817	-0.729	0.072	-3.399	-264.605
	(8.074)	(8.128)	(11.837)	(12.583)	(6.047)	(447.277)
$\ln PCGDP_{j,t}$	9.777***	9.791***	-4.364	-0.856	1.941***	1.885***
	(2.169)	(2.184)	(3.612)	(4.285)	(0.358)	(0.328)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	-266.627
						(453.221)
$\ln POP_{j,t}$	10.293***	10.313***	-5.414	-1.897	1.769***	2.673***
	(2.232)	(2.253)	(3.622)	(4.293)	(0.429)	(0.537)
$BORDER_{THj}$	1.879	n.a.	2.037***	1.957***	1.053**	n.a.
	(1.790)		(0.365)	(0.359)	(0.449)	
$TAGREE_{THj,t}$	0.165	0.165	0.081	0.072	0.436***	0.374**
	(0.105)	(0.106)	(0.116)	(0.120)	(0.137)	(0.139)
$GFCRISIS_t$	0.027	0.027	0.064	0.097	-0.010	-0.013
	(0.052)	(0.052)	(0.138)	(1.49)	(0.065)	(0.092)
$\ln RER_{THj,t}$	-0.062	-0.063	0.010	0.007	-0.038	-0.073*
	(0.041)	(0.040)	(0.026)	(0.026)	(0.059)	(0.036)
$PRODUCTUP_{TH,t}$	0.010**	0.010**	0.010	0.013	0.002	0.002
	(0.005)	(0.005)	(0.010)	(0.011)	(0.005)	(0.008)
$\ln PROCESSUP_{TH,t}$	-0.153*	-0.153*	-0.091	-0.113	0.030	0.049
	(0.079)	(0.079)	(0.290)	(0.314)	(0.122)	(0.232)
$\ln PROCESSUP_{TH,t-1}$	0.126**	0.125**	0.145	0.152	0.244***	0.250**
	(0.061)	(0.062)	(0.204)	(0.219)	(0.082)	(0.092)
$\ln FUNCUP_{TH,t}$	0.055**	0.054**	0.035	0.039	-0.0004	0.012
	(0.021)	(0.021)	(0.060)	(0.064)	(0.022)	(0.025)
$\ln FUNCUP_{TH,t-1}$	0.044	0.044	0.057	0.071	0.007	0.020
	(0.030)	(0.030)	(0.052)	(0.055)	(0.026)	(0.028)
$SOCUP_{TH,t}$	0.008**	0.008**	0.009	0.010	0.006	0.006
	(0.003)	(0.003)	(0.007)	(0.007)	(0.004)	(0.004)
Constant	-39.579	n.a.	-0.845	1.494	-6.900	10.623
	(27.702)		(42.519)	(45.273)	(21.787)	(30.485)
Observations	2,594	595	2594	595	418	418
R^2	n.a.	n.a.	n.a.	n.a.	0.5092	0.551
χ^2	515.18***	243.23***	1,031.59***	882.50***	253.22***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	15.32***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.

2. Numbers in parentheses are corrected standard errors.

3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.

4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

Table 5-2 Thailand's Total Processed Food Exports to Developed Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	12.596**	12.670**	n.a.	18.970***	4.755	-325.273
	(5.567)	(5.452)		(7.209)	(4.197)	(278.927)
$\ln GDP_{j,t}$	92.139*	96.621**	n.a.	69.312	69.464***	71.595**
	(53.064)	(45.974)		(50.112)	(23.594)	(26.352)
$\ln DIS_{THj}$	-0.629	n.a.	n.a.	-0.739	-1.033	n.a.
	(1.646)			(0.683)	(0.800)	
$\ln PCGDP_{TH,t}$	-16.157**	-16.218**	n.a.	-27.423***	-6.775	323.407
	(6.767)	(6.697)		(8.172)	(5.075)	(278.777)
$\ln PCGDP_{j,t}$	-90.874*	-95.379**	n.a.	-64.783	-68.568***	-70.746**
	(53.174)	(46.033)		(50.109)	(23.672)	(26.451)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	331.686
						(281.367)
$\ln POP_{j,t}$	-92.303*	-96.984**	n.a.	-67.856	-68.635***	-70.775**
	(54.900)	(47.430)		(50.111)	(23.617)	(27.034)
$BORDER_{THj}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	-0.062	-0.072	n.a.	0.131	-0.074	-0.080
	(0.103)	(0.093)		(0.098)	(0.061)	(0.054)
$GFCRISIS_t$	0.013	0.013	n.a.	-0.096	0.106*	0.137
	(0.060)	(0.060)		(0.090)	(0.063)	(0.094)
$\ln RER_{THj,t}$	0.105	0.111	n.a.	0.242***	0.089	0.066
	(0.112)	(0.107)		(0.053)	(0.108)	(0.205)
$PRODUCTUP_{TH,t}$	0.009*	0.010**	n.a.	0.009	0.015***	0.018**
	(0.005)	(0.005)		(0.006)	(0.004)	(0.006)
$\ln PROCESSUP_{TH,t}$	-0.036	-0.034	n.a.	-0.051	-0.144	-0.249
	(0.088)	(0.088)		(0.180)	(0.115)	(0.204)
$\ln PROCESSUP_{TH,t-1}$	0.206**	0.210**	n.a.	0.394***	0.215***	0.189**
	(0.090)	(0.090)		(0.133)	(0.062)	(0.075)
$\ln FUNCUP_{TH,t}$	0.090***	0.090***	n.a.	0.199***	0.068***	0.057*
	(0.028)	(0.028)		(0.043)	(0.023)	(0.028)
$\ln FUNCUP_{TH,t-1}$	0.059**	0.060**	n.a.	0.146***	0.083**	0.086**
	(0.027)	(0.028)		(0.036)	(0.033)	(0.039)
$SOCUP_{TH,t}$	0.008***	0.008***	n.a.	0.008*	0.008**	0.008**
	(0.002)	(0.002)		(0.005)	(0.003)	(0.003)
Constant	-46.263**	n.a.	n.a.	-88.820***	-16.423	-25.126
	(18.574)			(29.169)	(16.460)	(24.360)
Observations	547	196	n.a.	196	171	171
R^2	n.a.	n.a.	n.a.	n.a.	0.4817	0.4848
χ^2	145,852.3***	2,061.9***	n.a.	532.17***	29,842***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	16,803.9***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-RE cannot generate results because of a failure of statistical convergence.

Source: Author's calculations

Table 5-3 Thailand's Total Processed Food Exports to Developing Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	-9.870	-10.039	-6.548	-4.767	2.242	574.675
	(11.051)	(11.022)	(12.597)	(13.860)	(9.097)	(668.896)
$\ln GDP_{j,t}$	-8.750***	-8.741***	3.368	-0.884	-1.134*	-0.070
	(3.171)	(3.176)	(4.393)	(4.537)	(0.578)	(0.568)
$\ln DIS_{THj}$	-1.482	n.a.	-2.217***	-1.890***	-0.240*	n.a.
	(1.190)		(0.191)	(0.194)	(0.138)	
$\ln PCGDP_{TH,t}$	8.503	8.673	7.534	6.377	-2.051	-576.306
	(12.338)	(12.307)	(13.992)	(15.377)	(9.951)	(668.633)
$\ln PCGDP_{j,t}$	10.917***	10.913***	-1.826	2.141	1.329**	2.075***
	(3.096)	(3.101)	(4.367)	(4.520)	(0.531)	(0.431)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	-594.557
						(678.987)
$\ln POP_{j,t}$	12.484***	12.521***	-2.919	1.083	1.209**	3.816***
	(3.212)	(3.217)	(4.376)	(4.527)	(0.556)	(0.665)
$BORDER_{THj}$	3.471	n.a.	1.632***	1.361***	0.195	n.a.
	(3.433)		(0.455)	(0.432)	(0.255)	
$TAGREE_{THj,t}$	0.386**	0.387**	0.554***	0.640***	0.573***	0.462***
	(0.156)	(0.157)	(0.131)	(0.134)	(0.159)	(0.150)
$GFCRISIS_t$	0.119	0.119	0.071	0.159	-0.043	-0.133
	(0.141)	(0.141)	(0.162)	(0.183)	(0.102)	(0.137)
$\ln RER_{THj,t}$	-0.058**	-0.059**	-0.025	-0.025	-0.012	-0.055**
	(0.029)	(0.028)	(0.025)	(0.026)	(0.036)	(0.022)
$PRODUCTUP_{TH,t}$	0.016	0.016	0.007	0.013	-0.005	-0.010
	(0.011)	(0.011)	(0.011)	(0.013)	(0.008)	(0.012)
$\ln PROCESSUP_{TH,t}$	-0.394	-0.396	-0.179	-0.271	0.170	0.319
	(0.258)	(0.258)	(0.346)	(0.393)	(0.198)	(0.361)
$\ln PROCESSUP_{TH,t-1}$	0.168	0.168	0.035	-0.005	0.255*	0.346**
	(0.157)	(0.157)	(0.234)	(0.262)	(0.139)	(0.156)
$\ln FUNCUP_{TH,t}$	0.021	0.021	-0.046	-0.049	-0.039	0.002
	(0.050)	(0.050)	(0.067)	(0.073)	(0.035)	(0.041)
$\ln FUNCUP_{TH,t-1}$	0.074	0.075	0.030	0.049	-0.052	-0.026
	(0.050)	(0.050)	(0.058)	(0.065)	(0.042)	(0.043)
$SOCUP_{TH,t}$	0.005	0.005	0.006	0.007	0.006	0.004
	(0.007)	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)
Constant	35.895	n.a.	23.973	16.982	-6.153	71.935
	(43.190)		(50.004)	(55.045)	(36.636)	(49.927)
Observations	2,047	399	2,047	399	247	247
R^2	n.a.	n.a.	n.a.	n.a.	0.5280	0.6483
χ^2	441.97***	301.43***	711.92***	667.23***	665.92***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	38.89***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

5.1.2 Processed Shrimp Exports

The PPML estimates indicate that all upgrading types had significant impacts on processed shrimp exports to all countries during 1998-2016 (see Table 5-4). That is, product upgrading leads to Thai processed shrimp exports' expansion. The process upgrading (lagged) variable has a negative (positive) impact on processed shrimp exports at the 0.01 level. Briefly, the negative impact of process upgrading on exports is caused by a shift in production costs to meet various product requirements initially. However, the positive impact of the process upgrading lagged variable on exports indicates that learning by doing helps producers and exporters gain experience about how to comply with the standards. It also helps producers and exporters to achieve economies of scale and, subsequently, leads to decreased production costs and product prices. In addition, both functional upgrading and its lagged variables positively impact Thai processed shrimp exports at the 0.01 level. This agrees with previous studies that found some large Thai companies in the seafood industry acquired global brands in developed country markets to sell frozen and processed products. This effort enhances market channels and opportunities for product distribution (The Asia Foundation and International Labour Organisation, 2015; Thai Union Group Public Company Limited, 2016). There is a positive relationship at the 0.05 level between social upgrading and processed shrimp exports. This result can be explained by changes in consumer behaviour in developed countries (such as the U.S. and Japan), that are the primary buyers of Thailand's processed shrimp. This means developed countries' buyers paid more attention to labour conditions improvements associated with social upgrading (Dolan & Tewari, 2001; Lee & Gereffi, 2014; Thai Union Group Public Company Limited, 2016).

More interestingly, there are mixed results for the upgrading impact on Thai processed shrimp exports for different trading partner groups. The PPML estimates show that all upgrading types are statistically significant in Thai processed shrimp exports to developed country markets (see Table 5-5). That is, the product upgrading variable is positive and significant at the 0.01 level. The process upgrading (lagged) variable has a negative (positive) impact on the exports at the 0.05 level. Both functional upgrading and its lagged variables are positively significant at the 0.01 level. The social upgrading variable has a positive impact on the export at the 0.05 level. In contrast, almost all upgrading types are insignificant in these exports to developing nations (see Table 5-6). This is because developing countries are minor export markets and usually focus on product price (The Office of Industrial Economics, 2015). Consequently, the impact of economic and social upgrading on Thai processed shrimp exports to developing country markets is insignificant. The PPML-RE (PPML-FE) estimate suggests that the functional upgrading lagged variable is negatively significant in the processed shrimp exports to developing-country markets at the 0.1 (0.05) level. This is because large Thai processed shrimp companies own global brands in developed countries that are major markets for Thai processed

shrimp. An increase in functional upgrading attracts exporters to export their processed shrimp products to developed nations, rather than to developing nations.

To ensure the robustness of the PPML estimation outcomes, other methods are used. The NBPML estimate and standard panel model (REM and FEM) findings support the PPML results. For example, all alternative estimates argue that the product upgrading variable is positive and statistically significant in Thai processed shrimp exports to all countries (see Table 5-4). All alternative estimates indicate that almost all upgrading variables are insignificant in these exports to developing countries (see Table 5-6). Although some upgrading coefficients reported by the alternative estimations are statistically insignificant, the signs are similar to the PPML estimates (see Table 5-4). The conventional variables (GDP and distance) used in the gravity model are both statistically significant and insignificant; it depends on the trading partner. For the Thai and trading partner GDP variables, the PPML estimates show mixed outcomes. Only the Thailand GDP variable has a significant (at the 0.01 level) positive impact on Thai processed shrimp exports to all countries (see Table 5-4). Both the Thai and trading partner GDP variables are positive and statistically significant (at the 0.05 and 0.01 levels, respectively) for exports to developed countries (see Table 5-5). Conversely, the GDP variable of both Thailand and trading partner are negative and statistically significant (at the 0.05 and 0.01 level, respectively) for Thai processed shrimp exports to developing countries (see Table 5-6). For the distance variable, the PPML estimates suggest that the distance variable is positively (negatively) significant for processed shrimp exports to developed (developing) countries at the 0.05 (0.01) level. The positive relationship between the distance variable and Thai processed shrimp exports to developed countries is not surprising. This is because some large Thai companies in the processed shrimp industry have their own distribution channels in developed country markets (The Asia Foundation and International Labour Organisation, 2015; Thai Union Group Public Company Limited, 2016). This makes it easier to distribute products to places like the U.S., Japan and the EU.

To check the robustness of the results, estimates from NBPML, REM and FEM are used. The estimates from these methods support the findings of PPML estimation. For instance, all alternative estimates indicate that Thailand trading partner's GDP is statistically insignificant in processed shrimp exports to all countries (see Table 5-4). The NBPML-FE, REM and FEM estimates support the PPML results that the GDPs of Thailand and a trading partner are positively significant for exports to developed countries (see Table 5-5). However, the NBPML-FE method provides a different result from PPML; it posits a negative relationship between the distance variable and Thai processed shrimp exports to developed countries (see Table 5-5). This result contradicts the fact that increased distributor channels in developed countries should lead to reduced trade resistance caused by the distance between Thailand and importers located in developed countries.

With the GDP per capita variable, the PPML estimates suggest that only Thailand's GDP per capita is negatively significant (at the 0.01 level) in Thai processed shrimp exports to all countries (see Table 5-4). With the two particular groups of trading partners, the PPML estimate shows mixed outcomes. Both Thailand and its trading partners' GDP per capita variables are negatively (positively) significant for the exports of Thai processed shrimp to developed (developing) country markets at the 0.05 and 0.01 levels (see Tables 5-5 and 5-6). These findings imply that consumers in developed (developing) countries characterise Thai processed shrimp as labour-intensive (capital-intensive) and necessity (luxury) goods. This corresponds to the fact that most Thai processed shrimp products exported to developed countries are classified as made-to-order products (it is an OEM industry). This explains the need for the large workforce (Jespersen et al., 2014; Kohpaiboon, 2006; Thai Union Group Public Company Limited, 2016). To check the robustness of PPML estimates, we find that the alternative estimates support the results of PPML. For example, all alternative estimates confirm that Thailand trading partners' GDP per capita is insignificant in Thai processed shrimp exports to all countries (see Table 5-4). The NBPML estimates indicate that both Thailand's and its trading partners' GDP per capita variables are positively significant (at the 0.01 level) in exports to developing countries (see Table 5-6). However, the FEM estimates show that Thailand's GDP per capita is positively significant for exports of Thai processed shrimp to all countries and developed countries (see Tables 5-4 and 5-5). These results are inconsistent and contradict other estimates, such as by PPML and NBPML. According to Santos Silva and Tenreyro (2006), this problem can occur when using standard panel approaches (FEM and REM) to deal with the gravity model because of Jansen's inequality problem. In short, this problem leads to biased estimates when using the standard panel approach to deal with the gravity model.

For Thailand's trading partner population variable, the PPML estimates indicate that this variable is insignificant for Thai processed shrimp exports to all countries (see Table 5-4). For the groups of trading partners, the PPML estimates show that the trading partner population variable is positively (negatively) significant for the exports to developing (developed) countries at the 0.01 level (see Tables 5-5 and 5-6). Alternative estimates support the PPML estimates. For instance, the NBPML, FEM and REM results show no relationship between the variable and Thai processed shrimp exports to all countries (see Table 5-4). The NBPML estimates show a positive, significant (at the 0.01 level) impact of the variable on the exports to developing country markets (see Table 5-6).

The PPML estimates suggest that a common border is not significant for exports of Thai processed shrimp (see Tables 5-4 - 5-6). This is not surprising given that Thai processed shrimp's main importers are in developed nations. Although some alternative estimates (such as the NBPML-RE and NBPML-FE) show that a common border is statistically significant for the exports, the variable's sign is the same as the PPML estimate (see Tables 5-4 and 5-6). The PPML estimate indicates that trade agreements have a negative impact only on processed shrimp exports to developed countries at the 0.01 level. Almost

all alternative estimation methods agree with this result (see Tables 5-4 - 5-6). The negative trade agreement variable coefficient can be explained by several factors. For instance, the RoO[23] can create difficulties for exporters (Jongwattanakul, 2012; Kohpaiboon & Jongwanich, 2015). When trade agreements have been completely implemented, countries tend to seek new business channels to gain greater profits, or re-allocate their resources to create new products to export. Kohpaiboon and Jongwanich (2015) find that Thai exports under FTAs usually include the automotive sector, electric appliances and petrochemical products. In terms of the 2008 global financial crisis and the real exchange rate variables, the PPML estimates indicate no relationships between these variables and Thai processed shrimp exports (see Tables 5-4 - 5-6). Almost all alternative estimation methods gree with these findings. Although some estimation methods (such as NBPML-RE and NBPML-FE) suggest that the exchange rate variable is significant, thes coefficient's sign is the same as the PPML estimates.

[23] Sometimes, this criteria is complex. For example, Thai companies which produce processed shrimp for exports have to prove that their pure shrimp lines are locally produced. However, Thailand cannot produce them and need to import from overseas, especially from the U.S. In order to meet the RoO, Thailand is allowed to import the pure shrimp lines only from their trading partners. Importantly, the U.S. has full bargaining power to establish the pure shrimp lines' prices (Kohpaiboon & Jongwanich, 2015; The Office of Industrial Economics, 2015).

Table 5-4 Thailand's Processed Shrimp Exports to all Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	28.068***	28.972***	15.899	14.433	18.214**	-1517.41**
	(6.227)	(5.510)	(19.142)	(20.980)	(9.044)	(543.133)
$\ln GDP_{j,t}$	-39.347	-37.809	16.304	21.462	125.202	154.660
	(63.424)	(64.569)	(19.135)	(30.960)	(97.742)	(161.014)
$\ln DIS_{THj}$	-5.941	n.a.	-1.654***	-1.296***	-0.657***	n.a.
	(3.758)		(0.223)	(0.256)	(0.226)	
$\ln PCGDP_{TH,t}$	-38.630***	-39.609***	-24.043	-21.973	-25.693**	1509.84**
	(7.881)	(7.310)	(21.243)	(23.235)	(11.679)	(542.239)
$\ln PCGDP_{j,t}$	41.926	40.399	-14.269	-19.875	-123.873	-153.490
	(63.424)	(64.577)	(19.074)	(30.849)	(97.589)	(160.867)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	1552.26**
						(549.975)
$\ln POP_{j,t}$	36.044	33.829	-14.736	-20.144	-124.543	-158.213
	(64.335)	(64.902)	(19.130)	(30.941)	(97.749)	(162.095)
$BORDER_{THj}$	-19.766	n.a.	-1.874***	-2.100***	-0.076	n.a.
	(18.203)		(0.701)	(0.746)	(0.584)	
$TAGREE_{THj,t}$	-0.115	-0.143	-0.170	-0.220	-0.345**	-0.425***
	(0.195)	(0.158)	(0.173)	(0.198)	(0.154)	(0.137)
$GFCRISIS_t$	-0.044	-0.047	0.198	0.275	-0.098	-0.020
	(0.049)	(0.048)	(0.238)	(0.268)	(0.114)	(0.099)
$\ln RER_{THj,t}$	0.286	0.298	0.085*	0.124**	0.055	0.252
	(0.224)	(0.216)	(0.049)	(0.051)	(0.089)	(0.377)
$PRODUCTUP_{TH,t}$	0.025***	0.025***	0.040**	0.048**	0.022**	0.030***
	(0.005)	(0.005)	(0.017)	(0.020)	(0.010)	(0.010)
$\ln PROCESSUP_{TH,t}$	-0.351***	-0.346***	-0.897*	-1.054*	-0.168	-0.528
	(0.124)	(0.118)	(0.512)	(0.586)	(0.288)	(0.320)
$\ln PROCESSUP_{TH,t-1}$	0.513***	0.526***	0.619*	0.670*	0.477**	0.424**
	(0.155)	(0.153)	(0.362)	(0.403)	(0.230)	(0.194)
$\ln FUNCUP_{TH,t}$	0.285***	0.288***	0.261**	0.264**	0.227**	0.213**
	(0.037)	(0.035)	(0.106)	(0.118)	(0.091)	(0.074)
$\ln FUNCUP_{TH,t-1}$	0.240***	0.242***	0.305***	0.347***	0.142	0.144
	(0.042)	(0.040)	(0.100)	(0.115)	(0.114)	(0.105)
$SOCUP_{TH,t}$	0.015**	0.015**	0.011	0.012	0.015*	0.014*
	(0.006)	(0.006)	(0.013)	(0.014)	(0.008)	(0.008)
Constant	-79.092**	n.a.	-66.414	-59.296	-69.829**	-121.776**
	(31.907)		(76.097)	(83.340)	(34.838)	(42.670)
Observations	2,594	266	2,594	266	178	178
R^2	n.a.	n.a.	n.a.	n.a.	0.2694	0.3128
χ^2	2,151.9***	1,698.9***	324.19***	248.71***	n.a.	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	9,930.2***	165.24***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

Table 5-5 Thailand's Processed Shrimp Exports to Developed Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	34.151*** (8.803)	34.214** (8.829)	n.a.	33.759* (20.421)	21.534* (12.440)	-1827.79** (653.563)
$\ln GDP_{j,t}$	317.189*** (88.127)	324.704*** (82.467)	n.a.	143.518 (109.605)	-53.479 (158.616)	310.822*** (79.549)
$\ln DIS_{THj}$	4.234** (2.030)	n.a.	n.a.	-3.596*** (0.976)	0.909 (0.906)	n.a.
$\ln PCGDP_{TH,t}$	-46.276*** (12.210)	-46.271*** (12.230)	n.a.	-48.216** (22.818)	-37.176** (14.657)	1816.66** (652.607)
$\ln PCGDP_{j,t}$	-314.884*** (88.910)	-322.47*** (83.223)	n.a.	-139.228 (109.821)	57.226 (158.443)	-310.329*** (79.997)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	1872.98** (664.732)
$\ln POP_{j,t}$	-323.954*** (89.807)	-331.76*** (83.762)	n.a.	-142.467 (109.620)	54.462 (158.602)	-315.720*** (81.156)
$BORDER_{THj}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	-0.335** (0.135)	-0.351*** (0.120)	n.a.	-0.526* (0.306)	1.016** (0.490)	-0.472** (0.210)
$GFCRISIS_t$	-0.071 (0.087)	-0.070 (0.087)	n.a.	0.214 (0.278)	-0.709** (0.338)	0.235 (0.220)
$\ln RER_{THj,t}$	0.267 (0.188)	0.276 (0.182)	n.a.	0.335*** (0.092)	-0.087 (0.131)	-0.267 (0.466)
$PRODUCTUP_{TH,t}$	0.028*** (0.006)	0.028*** (0.006)	n.a.	0.055** (0.022)	-0.021 (0.027)	0.052*** (0.015)
$\ln PROCESSUP_{TH,t}$	-0.434** (0.189)	-0.433** (0.188)	n.a.	-1.334** (0.620)	0.240 (0.748)	-1.174** (0.496)
$\ln PROCESSUP_{TH,t-1}$	0.644** (0.256)	0.647** (0.258)	n.a.	1.124** (0.446)	1.113** (0.494)	0.521** (0.209)
$\ln FUNCUP_{TH,t}$	0.336*** (0.067)	0.336*** (0.066)	n.a.	0.394*** (0.119)	0.319*** (0.115)	0.279*** (0.071)
$\ln FUNCUP_{TH,t-1}$	0.317*** (0.057)	0.318*** (0.057)	n.a.	0.578*** (0.135)	0.242 (0.180)	0.366*** (0.100)
$SOCUP_{TH,t}$	0.015** (0.007)	0.015** (0.007)	n.a.	0.031** (0.013)	0.016 (0.014)	0.025** (0.008)
Constant	-107.346*** (39.900)	n.a.	n.a.	-136.367 (83.209)	-89.245* (50.914)	-151.07* (74.868)
Observations	547	168	n.a.	168	119	119
R^2	n.a.	n.a.	n.a.	n.a.	0.0959	0.5807
χ^2	$3.75x10^7$***	11,187.3***	n.a.	295.58***	636.62***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	6,536***

Note: 1. *, **, *** indicate statistically significant levels at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable of $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-RE cannot generate the result because of a failure of statistical convergence.

Source: Author's calculations

Table 5-6 Thailand's Processed Shrimp Exports to Developing Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	-45.116***	-39.272***	-50.833**	-55.538***	-14.186	-1018.376
	(16.358)	(13.969)	(19.911)	(20.032)	(14.354)	(915.709)
$\ln GDP_{j,t}$	-292.405**	-307.472***	-451.39***	-562.92***	104.445	-28.766
	(119.318)	(28.225)	(104.817)	(93.084)	(65.428)	(135.204)
$\ln DIS_{THj}$	-7.147***	n.a.	-6.179***	-6.554***	-0.817***	n.a.
	(2.614)		(0.772)	(0.783)	(0.104)	
$\ln PCGDP_{TH,t}$	52.863***	46.671***	61.657***	68.879***	20.027	1024.513
	(17.307)	(15.554)	(23.262)	(23.300)	(17.786)	(912.605)
$\ln PCGDP_{j,t}$	295.861**	310.780***	455.374***	566.938***	-102.953	30.539
	(118.897)	(28.561)	(104.9)	(93.240)	(64.968)	(135.310)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	1007.394
						(924.155)
$\ln POP_{j,t}$	295.045***	307.151***	454.396***	565.89***	-103.716	29.112
	(109.593)	(21.946)	(104.850)	(93.166)	(65.235)	(135.736)
$BORDER_{THj}$	-6.164	n.a.	-2.253**	-2.297**	0.273	n.a.
	(13.345)		(1.002)	(0.932)	(0.360)	
$TAGREE_{THj,t}$	0.191	0.178	-0.629***	-0.739***	-0.349**	-0.356***
	(0.387)	(0.407)	(0.202)	(0.183)	(0.142)	(0.064)
$GFCRISIS_t$	0.122	0.077	-0.094	-0.101	0.002	0.095
	(0.359)	(0.380)	(0.255)	(0.247)	(0.285)	(0.251)
$\ln RER_{THj,t}$	-0.348	-0.276	-1.295***	-1.536***	-0.134***	0.017
	(0.594)	(0.437)	(0.286)	(0.266)	(0.029)	(0.277)
$PRODUCTUP_{TH,t}$	-0.004	-0.007	0.025	0.030**	0.007	0.014
	(0.032)	(0.031)	(0.017)	(0.015)	(0.018)	(0.013)
$\ln PROCESSUP_{TH,t}$	0.549	0.632	-0.299	-0.354	0.094	-0.180
	(0.894)	(0.861)	(0.453)	(0.419)	(0.448)	(0.509)
$\ln PROCESSUP_{TH,t-1}$	-0.592	-0.557	-0.771	-0.979**	-0.266	-0.367
	(0.463)	(0.497)	(0.482)	(0.407)	(0.482)	(0.499)
$\ln FUNCUP_{TH,t}$	-0.118	-0.108	-0.277*	-0.352***	-0.093	-0.110
	(0.094)	(0.091)	(0.158)	(0.133)	(0.151)	(0.142)
$\ln FUNCUP_{TH,t-1}$	-0.428*	-0.436**	-0.241***	-0.271***	-0.266**	-0.255
	(0.225)	(0.216)	(0.090)	(0.087)	(0.125)	(0.144)
$SOCUP_{TH,t}$	0.008	0.008	0.009	0.012	0.011	0.012
	(0.015)	(0.015)	(0.014)	(0.012)	(0.018)	(0.017)
Constant	172.521***	n.a.	188.938**	207.021***	50.612	38.743
	(50.640)		(78.414)	(78.832)	(56.369)	(62.916)
Observations	2,047	98	2,047	98	59	59
R^2	n.a.	n.a.	n.a.	n.a.	0.5793	0.6267
χ^2	$9.15x10^{6}$***	1,208.31***	195.11***	162.83***	119.56***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	$1x10^{5}$***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

5.1.3 Processed Chicken Exports

Tables 5-7 to 5-9 present the gravity model estimates for processed chicken exports. The results are separated into three trading partner groups: all countries, developed countries, and developing countries. The PPML estimates indicate that all upgrading types play a vital role as the growth engine of processed chicken exports to all countries (see Table 5-7). That is, product upgrading is positively significant (at the 0.01 level) for processed chicken exports. This finding is similar to total processed food and processed shrimp above where product upgrading is a positively significant variable. The processed chicken value chain in Thailand is primarily a captive chain. Product upgrading is a central reason for upgrading within a captive chain (Bazan & Navas-Alemán, 2001; Humphrey & Schmitz, 2002; Knorringa & Pegler, 2006; Schmitz, 2006). The PPML estimates indicate that the process upgrading variable is negatively significant (at the 0.01 level) for Thai processed chicken exports to all countries. This is related to the appearance of bird flu and its impact on the Thai chicken industry between 2004 and 2005. To continue exporting chicken, especially to developed countries, Thailand had to adapt its exporting products to meet the food safety standards proposed by developed countries. There are strict product standards regulating processed chicken quality (Heft-Neal et al., 2008; Krungsri Research, 2017). Accordingly, processed chicken has become a key export product of the Thai chicken industry, instead of raw chicken products. There has been substantial capital and research injected into the industry to enhance consumers' confidence globally (Heft-Neal et al., 2008; Krungsri Research, 2017). This led to increased production costs and, subsequently, export prices. As a result, process upgrading can have a negative impact on Thailand's processed chicken exports. The PPML-RE and PPML-FE estimates indicate that the functional upgrading lagged variable is positively significant (at the 0.05 and 0.01 levels, respectively) in Thai processed chicken exports. The social upgrading variable is also positively significant for exports like total processed food and processed shrimp. The social upgrading variable is significant at the 0.05 and 0.01 levels by the PPML-RE and PPML-FE methods, respectively.

For Thai processed chicken exports to developed and developing countries, the PPML estimates provide mixed results. They indicate that almost all upgrading types affect processed chicken exports' expansion to developed countries (see Table 5-8). That is, product upgrading, functional upgrading and social upgrading are positively significant in such exports at the 0.01 level. Process upgrading has a significant negative (at the 0.01 level) impact on Thai processed chicken exports to developed countries. In contrast, most upgrading types play a minor role in the growth engine of the exports to developing countries (see Table 5-9). The PPML-FE estimates show that only product upgrading is positively significant (at the 0.05 level) for exports to developing countries. There are various reasons for this. Thai processed chicken's main export markets are developed countries. These countries have

more stringent product standards and are more concerned with product quality than developing countries (Buzby, 2001; Dolan & Tewari, 2001; Lee & Gereffi, 2014; Ponte, 2002).

To investigate the robustness of the PPML outcomes on the upgrading impact on Thai processed chicken exports, several alternative estimation methods were used to support the PPML findings. For instance, the NBPML estimates indicate that product, process and functional upgrading have positive impacts on Thai processed chicken exports to all countries. Although some alternative estimation methods suggest that many upgrading types are insignificant, most coefficient signs of the upgrading variables are the same as the PPML estimates (see Tables 5-7 - 5-9). For example, the NBPML-RE and NBPML-FE results indicate that process and social upgradings are insignificant for Thai processed chicken exports to developed countries. However, the coefficients' signs of these two variables are like the PPML outcomes (see Table 5-8).

For the conventional variables (GDP and distance), the PPML estimates suggest that the Thai GDP variable is significant in Thai processed chicken exports to all countries and developed countries at the 0.1 and 0.05 levels, respectively. In contrast, Thai and trading partners' GDP variables are negatively significant for the exports to developing nations at the 0.05 and 0.01 levels, respectively. The PPML estimates also show that the distance variable is negatively significant (at the 0.05 level) for only the exports of Thai processed chicken to all countries. However, with the two separate groups of trading partners, developed and developing countries, PPML estimates show that there is no relationship between the distance variable and Thai processed chicken exports to the countries (see Tables 5-8 and 5-9). Other methods' estimates support these findings. For instance, the NBPML-RE and FEM estimates suggest that Thai GDP is a positive variable for processed chicken exports to developed countries (see Table 5-8). The NBPML-FE, REM and FEM findings indicate that both Thailand and trading partners' GDPs are negatively significant for these exports to developing countries (see Table 5-9).

The PPML estimates suggest that both Thailand and its trading partners' GDP per capita are insignificant for Thai processed chicken exports to all countries (see Table 5-7). However, when exports to developed- and developing-country markets are considered separately, the PPML estimates provide mixed results. Both Thailand's and its trading partners' GDP per capita are still insignificant for Thai processed chicken exports to developed countries (see Table 5-8). In contrast, PPML-RE and PPML-FE estimates suggest that both GDPs per capita are positively, statistically significant for exports to developing countries markets. This means that Thai processed chicken products exported to developing countries are characterised as capital-intensive and luxury goods. These results are similar to the results for total processed food and processed shrimp exports to developing countries. To check the robustness of PPML estimates, the results show that almost all alternative methods produce similar findings. For example, the NBPML-FE, REM and FEM outcomes indicate that both Thai and trading

partners GDPs per capita are not significant for Thai processed chicken exports to all countries (see Table 5-7). The NBPML-FE, REM and FEM estimates suggest that the GDP per capita variables of both Thailand and its trading partners are positively significant for exports to developing countries (see Table 5-9).

The PPML estimate reveals that Thailand's trading partners' populations are insignificant in Thai processed chicken exports to all countries. This finding is supported by all of the alternative methods' results (see Table 5-7). The PPML estimate indicates that the variable is insignificant for exports to developed countries (see Table 5-8). In contrast, the PPML estimate suggests that Thailand's trading partners' population variable is positively significant (at the 0.01 level) for Thai processed chicken exports to developing countries. Almost all of the alternative estimates confirm these findings (see Tables 5-8 and 5-9).

With respect to other regressors, the PPML estimates indicate that the common border variable is negatively significant for the exports of Thai processed chicken to all countries but is insignificant for developing countries. The PPML estimates reveal that trade agreements are insignificant in Thai processed chicken exports to all countries (see Table 5-7). Moreover, the PPML estimates suggest that there is no statistical relationship between the trade agreement variable and these exports to developed countries (see Table 5-8). This corresponds with the fact that, during 1998-2016 exporters had to gain quotas for Thai processed chicken, especially for exports to the EU (Thailand's Office of Agricultural Affairs, 2016). Hence, trade agreements can be insignificant for the processed chicken exports to developed countries. Although the REM and FEM results show that the trade agreement variable is significant for exports to developed nations, this finding is contradicted by other estimates, such as from PPML and NBPML. In addition, the findings of REM and FEM are contradicted by the fact that Thai processed chicken exports to developed countries rely heavily on quotas from those nations, rather than trade agreements (Thailand's Office of Agricultural Affairs, 2016). As a result, the standard panel estimation method seems to be futile. On the other hand, the PPML estimates show that a trade agreement is positively significant (at the 0.01 level) for Thai processed chicken exports to developing countries. During 1998-2016, Singapore and South Korea, which have had trade agreements with Thailand, were the two main export markets in the group of developing countries[24] (Department of Trade Negotiations, 2017; UN Comtrade, 2017; The United Nations, 2016). For the 2008 global financial crisis, the PPML estimates show a positive relationship (at the 0.01 level) for Thai processed chicken

[24] From the literature, there is no single benchmark used to classify developed and developing countries. The country classification is subject to the criteria of each international organisation. For example, the United Nations and International Monetary Fund classify Singapore and South Korea as developing countries and developed countries, respectively (The United Nations, 2016; International Monetary Fund, 2016). For consistency, we follow the country classification of the United Nations. This because most data used in the study are from the United Nations database.

exports to all countries and to developed countries (see Tables 5-7 and 5-8). The NBPML estimates support this finding. The PPML estimates suggest that the real exchange rate is positively significant (at the 0.01 level) for Thai processed chicken exports to all countries and developed countries (see Tables 5-7 and 5-8). These findings are supported by the alternative methods. Depreciation of the Thai baht leads to a decrease in Thai processed chicken export prices and, subsequently, expansion of its exports.

Table 5-7 Thailand's Processed Chicken Exports to all Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	17.156	14.357*	21.550**	12.500	-6.447	251.757
	(13.247)	(8.627)	(10.888)	(11.145)	(11.297)	(709.94)
$\ln GDP_{j,t}$	89.376	72.939	37.208	61.311	30.087	12.728
	(68.329)	(47.185)	(58.696)	(63.740)	(73.074)	(78.724)
$\ln DIS_{THj}$	-1.437**	n.a.	-1.928***	-1.755***	-1.108***	n.a.
	(0.617)		(0.257)	(0.298)	(0.323)	
$\ln PCGDP_{TH,t}$	-16.046	-12.345	-22.158*	-11.629	6.757	-250.400
	(16.329)	(9.739)	(11.962)	(12.305)	(13.705)	(709.219)
$\ln PCGDP_{j,t}$	-88.504	-72.638	-35.350	-61.189	-29.319	-12.510
	(66.751)	(46.852)	(58.728)	(63.608)	(72.503)	(78.078)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	-265.049
						(723.686)
$\ln POP_{j,t}$	-87.767	-71.363	-35.404	-59.645	-28.682	-9.271
	(68.704)	(47.782)	(58.673)	(63.702)	(73.100)	(79.414)
$BORDER_{THj}$	-25.368***	n.a.	-21.99	n.a.	n.a.	n.a.
	(4.595)		(5224.417)			
$TAGREE_{THj,t}$	0.161	0.160	0.170*	0.175	0.441***	0.540***
	(0.114)	(0.139)	(0.098)	(0.115)	(0.102)	(0.113)
$GFCRISIS_t$	0.397***	0.416***	0.337**	0.297**	0.040	0.067
	(0.082)	(0.053)	(0.139)	(0.150)	(0.158)	(0.189)
$\ln RER_{THj,t}$	0.292***	0.295***	0.405***	0.528***	0.397*	0.333
	(0.010)	(0.097)	(0.081)	(0.091)	(0.234)	(0.346)
$PRODUCTUP_{TH,t}$	0.024***	0.025***	0.019*	0.020*	0.005	0.007
	(0.005)	(0.004)	(0.010)	(0.010)	(0.009)	(0.012)
$\ln PROCESSUP_{TH,t}$	-0.713***	-0.713***	-0.604*	-0.434	0.009	0.034
	(0.147)	(0.137)	(0.309)	(0.327)	(0.312)	(0.482)
$\ln PROCESSUP_{TH,t-1}$	-0.068	-0.099	0.041	0.128	0.382*	0.323
	(0.218)	(0.180)	(0.221)	(0.229)	(0.223)	(0.239)
$\ln FUNCUP_{TH,t}$	0.017	0.003	0.044	0.051	0.063	0.042
	(0.066)	(0.044)	(0.057)	(0.061)	(0.061)	(0.059)
$\ln FUNCUP_{TH,t-1}$	0.119**	0.113***	0.120**	0.119**	0.123*	0.116
	(0.046)	(0.039)	(0.050)	(0.053)	(0.072)	(0.070)
$SOCUP_{TH,t}$	0.005**	0.004***	0.008	0.007	0.002	0.003
	(0.002)	(0.001)	(0.006)	(0.006)	(0.007)	(0.007)
Constant	-76.409	n.a.	-96.521**	-55.364	21.726	42.918
	(56.144)		(43.815)	(44.746)	(45.772)	(64.137)
Observations	2,594	210	2,594	210	160	160
R^2	n.a.	n.a.	n.a.	n.a.	0.5678	0.5828
χ^2	72,824.8***	22,372.7***	517.0***	459.33***	2.1×10^8***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	164.51***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i} - 1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

Table 5-8 Thailand's Processed Chicken Exports to Developed Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	14.730	11.709**	25.989**	17.490	7.698	-765.102*
	(18.464)	(5.921)	(13.001)	(13.772)	(18.037)	(357.471)
$\ln GDP_{j,t}$	38.622	5.260	123.413*	54.324	68.430	-30.892
	(200.048)	(41.702)	(63.680)	(71.074)	(151.925)	(104.984)
$\ln DIS_{THj}$	-6.355	n.a.	-2.768**	-2.952**	-5.139***	n.a.
	(8.909)		(1.173)	(1.241)	(0.992)	
$\ln PCGDP_{TH,t}$	-12.027	-8.052	-28.666**	-17.745	-2.644	768.745*
	(24.051)	(7.108)	(14.579)	(15.644)	(22.902)	(356.033)
$\ln PCGDP_{j,t}$	-39.057	-6.348	-120.773*	-54.430	-68.619	29.986
	(196.195)	(41.438)	(63.269)	(70.404)	(149.378)	(102.910)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	763.501*
						(369.128)
$\ln POP_{j,t}$	-40.522	-8.348	-121.986*	-53.223	-67.959	31.270
	(192.942)	(41.617)	(63.681)	(70.995)	(151.836)	(103.615)
$BORDER_{THj}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	-0.012	-0.065	0.070	0.005	1.189*	0.342*
	(0.367)	(0.139)	(0.133)	(0.157)	(0.706)	(0.182)
$GFCRISIS_t$	0.480***	0.505***	0.285	0.325*	0.354	0.369
	(0.152)	(0.049)	(0.177)	(0.180)	(0.280)	(0.211)
$\ln RER_{THj,t}$	0.258***	0.257***	0.595***	0.665***	0.703***	0.195
	(0.076)	(0.070)	(0.125)	(0.145)	(0.207)	(0.336)
$PRODUCTUP_{TH,t}$	0.029***	0.031***	0.018	0.025*	0.021	0.025
	(0.010)	(0.003)	(0.012)	(0.013)	(0.018)	(0.014)
$\ln PROCESSUP_{TH,t}$	-0.767***	-0.765***	-0.494	-0.479	-0.479	-0.643
	(0.120)	(0.121)	(0.377)	(0.379)	(0.439)	(0.380)
$\ln PROCESSUP_{TH,t-1}$	-0.089	-0.091	0.206	0.205	-0.493	-0.074
	(0.147)	(0.137)	(0.273)	(0.269)	(0.399)	(0.200)
$\ln FUNCUP_{TH,t}$	-0.001	-0.011	0.117	0.093	-0.126	-0.043
	(0.069)	(0.032)	(0.080)	(0.080)	(0.124)	(0.076)
$\ln FUNCUP_{TH,t-1}$	0.122***	0.122***	0.146**	0.149*	-0.001	0.135
	(0.028)	(0.026)	(0.063)	(0.066)	(0.099)	(0.082)
$SOCUP_{TH,t}$	0.004	0.004***	0.007	0.007	0.018	0.010
	(0.003)	(0.001)	(0.008)	(0.008)	(0.013)	(0.008)
Constant	-38.461	n.a.	-113.786**	-69.959	-23.787	8.488
	(129.352)		(52.827)	(56.310)	(77.891)	(73.598)
Observations	547	154	547	154	114	114
R^2	n.a.	n.a.	n.a.	n.a.	0.3188	0.4778
χ^2	$1.3x10^9$***	$1.8x10^{10}$***	298.44***	251.77***	$1.4x10^5$***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	$1.2x10^6$***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

Table 5-9 Thailand's Processed Chicken Exports to Developing Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	-82.964**	-82.868**	n.a.	-42.970*	-25.019	3681.616
	(32.930)	(33.249)		(23.398)	(27.929)	(1910.013)
$\ln GDP_{j,t}$	-321.243**	-305.797***	n.a.	-261.484*	-158.40*	-547.56***
	(125.707)	(105.648)		(150.632)	(93.123)	(46.535)
$\ln DIS_{THj}$	-26.694	n.a.	n.a.	-5.370***	-1.219***	n.a.
	(53.764)			(0.898)	(0.322)	
$\ln PCGDP_{TH,t}$	95.307**	97.391**	n.a.	47.271*	25.705	-3682.111
	(42.061)	(38.394)		(25.594)	(34.559)	(1909.526)
$\ln PCGDP_{j,t}$	319.794**	302.875***	n.a.	260.961*	156.832*	551.725***
	(132.597)	(106.587)		(151.673)	(93.020)	(46.039)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	-3778.726
						(1938.62)
$\ln POP_{j,t}$	329.752***	314.444***	n.a.	265.700*	160.508*	557.963***
	(124.971)	(105.976)		(151.232)	(92.964)	(46.408)
$BORDER_{THj}$	-97.069	n.a.	n.a.	n.a.	n.a.	n.a.
	(156.835)					
$TAGREE_{THj,t}$	1.016***	0.988***	n.a.	1.172***	0.561***	1.027***
	(0.291)	(0.262)		(0.307)	(0.190)	(0.110)
$GFCRISIS_t$	0.211	0.229	n.a.	0.183	-0.226	-0.439
	(0.264)	(0.209)		(0.314)	(0.189)	(0.469)
$\ln RER_{THj,t}$	-0.314	-0.467	n.a.	1.144***	0.756*	-0.514
	(1.262)	(0.613)		(0.301)	(0.424)	(0.521)
$PRODUCTUP_{TH,t}$	0.017	0.022**	n.a.	0.025	-0.0001	-0.043
	(0.036)	(0.009)		(0.025)	(0.032)	(0.032)
$\ln PROCESSUP_{TH,t}$	0.267	0.172	n.a.	-0.131	0.592	2.334
	(0.884)	(0.672)		(0.720)	(0.429)	(1.212)
$\ln PROCESSUP_{TH,t-1}$	0.267	0.183	n.a.	0.731	1.065***	0.798
	(0.755)	(0.438)		(0.458)	(0.162)	(0.374)
$\ln FUNCUP_{TH,t}$	-0.057	-0.099	n.a.	0.132	0.163	0.175
	(0.328)	(0.151)		(0.125)	(0.107)	(0.080)
$\ln FUNCUP_{TH,t-1}$	0.065	0.067	n.a.	0.263**	0.192**	-0.160
	(0.116)	(0.119)		(0.113)	(0.093)	(0.164)
$SOCUP_{TH,t}$	-0.002	-0.002	n.a.	-0.0004	-0.013	-0.015
	(0.004)	(0.005)		(0.012)	(0.017)	(0.013)
Constant	355.566**	n.a.	n.a.	166.656*	99.689	361.305
	(178.761)			(92.913)	(110.439)	(114.533)
Observations	2,047	56	n.a.	56	46	46
R^2	n.a.	n.a.	n.a.	n.a.	0.7498	0.8671
χ^2	$1.1x10^9$***	195.20***	n.a.	182.01***	36,876.5***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	$5.6x10^6$***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-RE cannot generate the result becauseof a failure of statistical convergence.

Source: Author's calculations

5.1.4 Canned Tuna Exports

Tables 5-10 to 5-12 show the estimates for Thai canned tuna exports, divided into the three trading partner groups. For exports to all countries, the PPML estimates show that product upgrading is positively significant (at the 0.01 level) for Thai canned tuna exports (see Table 5-10). Conversely, the process upgrading variable is negatively significant at the 0.01 level. This may be related to a shift in production costs of exporters and producers and, subsequently, to higher export prices because of adapting their production processes to meet global product standards (Baylis et al., 2010; Jouanjean et al., 2015; Ponte, 2002). The PPML-FE estimate indicates that the functional upgrading lagged variable and social upgrading variable are positively significant (at the 0.01 level) for Thai canned tuna exports to all countries (see Table 5-10).

For Thai canned tuna exports to developed and developing countries, the PPML estimates provide mixed findings. For exports to developed countries, all upgrading types are significant for canned tuna exports (see Table 5-11). Product upgrading is positively significant (at the 0.01 level) for exports to developed countries. This is true for all estimation methods. For process upgrading, the PPML estimates indicate that this variable is negatively significant at the 0.01 level (see Table 5-11). This is because there are various product standards that producers/exporters need to meet and these require significant amounts of time and financial investment (Baylis et al., 2010; Jouanjean et al., 2015; Ponte, 2002). The PPML estimates indicate that the functional upgrading variable has a significant positive (at the 0.01 level) impact on Thai canned tuna exports to developed countries. This agrees with previous studies that found some large Thai canned tuna companies acquired global brands to enhance their distribution channels in these markets (Kohpaiboon, 2006; Thai Union Group Public Company Limited, 2016). This PPML estimate is supported by the NBPML and standard panel estimates (REM and FEM) (see Table 5-11). Furthermore, all estimation methods acknowledge that social upgrading is positively, statistically significant in Thai canned tuna exports to developed countries. For example, PPML estimates indicate that the social upgrading variable is positively significant at the 0.01 level (see Table 5-11). In contrast, the PPML estimates suggest that only product and social upgrading play a vital role in the growth of Thai canned tuna exports to developing countries. Social upgrading is particularly important, not only for Thai canned tuna exports to developed countries but also to developing countries. The Office of Industrial Economics (2015) states that social upgrading has become a key determinant influencing canned tuna exports in world markets. This is because most countries are concerned about the IUU problem that occurred in the fishery sector. Alternative estimation methods support most PPML findings. In particular, the alternative methods suggest that social upgrading is positively significant for Thai canned tuna exports to both developed and developing countries (see Tables 5-11 and 5-12).

For the GDP and distance variables, the PPML estimates show no relationship between these variables and Thai canned tuna exports to all countries (see Table 5-10). However, for the separate groups of trading partners, the PPML estimates show that only the trading partner's GDP is positively significant (at the 0.05 and 0.1 levels) for canned tuna exports to both developed- and developing-countries markets, respectively. The insignificance of the distance variable may be related to developments in food technology and increased product distribution channels for Thai canned tuna companies in developed countries that can lead to reduced trade resistance based on geographic distance (Athukorala et al., 2002; Thai Union Group Public Company Limited, 2016). To check the robustness of the PPML findings in relation to the impact of the GDP and distance variables, alternative estimation methods are used, i.e., NBPML, FEM and REM. Although some alternative estimation methods suggest that the GDP and distance variables are significant, most coefficients' signs of these variables are like the PPML result (see Tables 5-10 - 5-12). For instance, the NBPML-RE and the NBPML-FE estimates show that Thailand's trading partners' GDP is positively significant (at the 0.01 level) for Thai canned tuna exports to all countries (see Table 5-10). The NBPML-RE estimates reveal that the distance variable is negatively significant (at the 0.01 level) for Thai canned tuna exports to developing countries (see Table 5-12).

For the GDP per capita and population variables, the PPML estimates indicate that these two variables are not significant for exports of Thai canned tuna to all countries (see Table 5-10). In contrast, for exports to developed and developing countries, the PPML estimates suggest that both Thailand trading partners' GDP per capita and population variables are negatively significant at the 0.05 and 0.1 levels (see Tables 5-11 and 5-12). The former means that Thai canned tuna exported to both developed and developing countries is classified as necessities. This is different from the previous products (processed shrimp and chicken products) since these products exported to developing countries are characterised as luxury goods. This is because processed shrimp and chicken products exhibit numerous variations (such as shrimp cocktails and roast chicken). This practice is described as 'value-added'. On the other hand, canned tuna is sold in a less processed form (canned tuna in water or oil) (Kohpaiboon, 2006). In addition, increasing populations of both trading partner groups leads to less reliance on the international trade with trading partners. In short, Thailand cannot develop greater opportunities to expand tuna exports. To ensure the robustness of the PPML estimates, the NBPML, REM and FEM methods were used. The NBPML, FEM and REM findings argue that both GDP per capita and population variables are insignificant for exports of Thai canned tuna to all countries (see Table 5-10). The NBPML-RE and FEM estimates support the PPML findings that Thailand trading partners' GDP per capita and population are negatively significant (at the 0.01 level) for Thai canned tuna exports to developing countries (see Table 5-12). However, some alternative estimates provide different results from the PPML estimates. For instance, the REM results indicate that Thai GDP per capita is positively significant

for the exports of Thai canned tuna to developed countries (see Table 5-11). This means that the Thai canned tuna industry is capital-intensive. However, this result is contradicted by the fact that canned tuna produced for exports to developed countries is labour-intensive (Hamilton et al., 2011; Kohpaiboon, 2006).

The PPML estimates suggest that the common border variable is negatively significant (at the 0.1 level) for Thai canned tuna exports to all countries (see Table 5-10). In contrast, this variable is insignificant for exports to developing countries (see Table 5-12). These results correspond to the fact that Thai canned tuna's main export markets are developed countries and not neighbouring countries. The PPML estimates indicate that trade agreements are not significant for Thai canned tuna exports (see Tables 5-10 - 5-12). In addition, the PPML estimates suggest that the 2008 global financial crisis variable had a positive impact on Thai canned tuna exports at the 0.01 level. The crisis effect was felt between the last quarter of 2008 and the first half of 2009; world markets recovered in the last quarter of 2009. Its impact seems to be marginal, especially when export data are reported as annually aggregated data (Jongwattanakul, 2012). Likewise, the PPML-FE estimates suggest that the real exchange rate has a positive (at the 0.1 level) impact on Thai canned tuna exports only to developing countries (see Table 5-12). To investigate the robustness of PPML findings, alternative estimates (such as the NBPML, FEM and REM) provide a variety of findings. For the real exchange rate, although the NBPML and REM estimates suggest that the real exchange rate is statistically significant for Thai canned tuna exports to all countries, the real exchange rate coefficient sign is the same as the PPML estimates (see Table 5-10). The NBPML-RE and FEM estimates indicate that trade agreements are significant for Thai canned tuna exports to developing countries (see Table 5-12). These estimates disagree with the PPML result. However, the findings of NBPML-RE and FEM are inconsistent. That is, the NBPML-RE estimate indicates that the agreement variable has a negative impact on the exports. In contrast, the FEM findings suggest that this variable has a positive impact on exports (see Table 5-12). The FEM finding shows that the real exchange rate is a positively significant variable. This finding is the same as the PPML-FE result (see Table 5-12).

Table 5-10 Thailand's Canned Tuna Exports to all Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	1.917	1.463	3.559	1.847	-9.714*	-291.017
	(6.798)	(6.827)	(11.288)	(12.280)	(5.314)	(340.799)
$\ln GDP_{j,t}$	15.267	16.230	52.047***	56.175***	1.658	4.544
	(15.435)	(15.991)	(10.945)	(11.114)	(7.071)	(9.676)
$\ln DIS_{THj}$	-0.774	n.a.	-1.975***	-2.150***	0.045	n.a.
	(1.136)		(0.433)	(0.480)	(0.359)	
$\ln PCGDP_{TH,t}$	-1.649	-1.154	-3.491	-1.501	13.208**	294.025
	(8.450)	(8.470)	(12.499)	(13.560)	(6.151)	(341.023)
$\ln PCGDP_{j,t}$	-13.958	-14.932	-51.240***	-55.47***	-1.523	-3.974
	(15.355)	(15.891)	(10.939)	(11.108)	(7.067)	(9.651)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	278.553
						(343.595)
$\ln POP_{j,t}$	-12.581	-13.382	-51.354***	-55.630***	-1.264	-2.468
	(15.361)	(15.941)	(10.952)	(11.126)	(7.109)	(9.653)
$BORDER_{THj}$	-5.313*	n.a.	-2.183	-1.967	-0.944	n.a.
	(2.805)		(1.485)	(2.155)	(0.830)	
$TAGREE_{THj,t}$	0.172	0.182	0.126	0.103	0.100	0.204**
	(0.168)	(0.168)	(0.129)	(0.142)	(0.117)	(0.096)
$GFCRISIS_t$	0.276***	0.282***	0.148	0.133	0.243**	0.243**
	(0.095)	(0.094)	(0.149)	(0.164)	(0.096)	(0.109)
$\ln RER_{THj,t}$	0.120	0.099	0.314***	0.287***	0.141***	0.132
	(0.126)	(0.139)	(0.040)	(0.043)	(0.044)	(0.095)
$PRODUCTUP_{TH,t}$	0.018***	0.019***	0.013	0.011	0.011*	0.012
	(0.005)	(0.005)	(0.010)	(0.011)	(0.006)	(0.008)
$\ln PROCESSUP_{TH,t}$	-0.553***	-0.565***	-0.064	0.045	-0.277*	-0.345
	(0.116)	(0.113)	(0.309)	(0.343)	(0.156)	(0.218)
$\ln PROCESSUP_{TH,t-1}$	-0.105	-0.110	-0.145	-0.123	-0.141	-0.132
	(0.118)	(0.117)	(0.217)	(0.240)	(0.118)	(0.126)
$\ln FUNCUP_{TH,t}$	-0.001	-0.003	0.037	0.037	-0.019	-0.024
	(0.042)	(0.041)	(0.064)	(0.069)	(0.036)	(0.037)
$\ln FUNCUP_{TH,t-1}$	0.118	0.119***	0.075	0.065	0.062*	0.075**
	(0.044)	(0.043)	(0.054)	(0.058)	(0.032)	(0.035)
$SOCUP_{TH,t}$	0.025***	0.025***	0.023***	0.023***	0.012***	0.013***
	(0.003)	(0.003)	(0.007)	(0.008)	(0.005)	(0.005)
Constant	-12.766	n.a.	-15.054	-7.588	37.599*	43.859*
	(26.968)		(44.914)	(48.853)	(21.235)	(24.988)
Observations	2,594	695	2,594	695	449	449
R^2	n.a.	n.a.	n.a.	n.a.	0.2870	0.3730
χ^2	246.20***	244.97***	505.48***	419.94***	123.66***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	13.60***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).

Source: Author's calculations

Table 5-11 Thailand's Canned Tuna Exports to Developed Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	-4.063 (9.119)	-5.166 (8.753)	n.a.	9.019 (11.213)	-16.409** (7.206)	-143.952 (459.172)
$\ln GDP_{j,t}$	52.042** (20.915)	54.438** (25.182)	n.a.	64.943 (46.478)	90.585 (65.271)	79.956 (54.193)
$\ln DIS_{THj}$	-0.426 (1.327)	n.a.	n.a.	-2.237*** (0.709)	0.123 (0.931)	n.a.
$\ln PCGDP_{TH,t}$	5.892 (11.463)	7.403 (10.619)	n.a.	-10.274 (12.597)	19.355** (8.277)	148.258 (460.032)
$\ln PCGDP_{j,t}$	-53.236** (21.296)	-55.953** (25.011)	n.a.	-63.488 (46.516)	-90.508 (65.376)	-80.852 (54.392)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	123.313 (461.206)
$\ln POP_{j,t}$	-50.519** (20.868)	-52.881** (26.082)	n.a.	-64.204 (46.472)	-89.966 (65.307)	-78.448 (54.063)
$BORDER_{THj}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	0.095 (0.061)	0.094 (0.078)	n.a.	0.194 (0.122)	0.185** (0.072)	0.123* (0.066)
$GFCRISIS_t$	0.313*** (0.106)	0.326*** (0.098)	n.a.	0.216 (0.142)	0.296** (0.119)	0.370** (0.144)
$\ln RER_{THj,t}$	0.112 (0.112)	0.106 (0.103)	n.a.	0.485*** (0.054)	0.118** (0.055)	0.113 (0.138)
$PRODUCTUP_{TH,t}$	0.022*** (0.006)	0.022*** (0.006)	n.a.	0.020** (0.010)	0.015* (0.008)	0.021* (0.011)
$\ln PROCESSUP_{TH,t}$	-0.612*** (0.117)	-0.620*** (0.115)	n.a.	-0.405 (0.295)	-0.363* (0.213)	-0.445 (0.320)
$\ln PROCESSUP_{TH,t-1}$	-0.185 (0.151)	-0.201 (0.143)	n.a.	-0.208 (0.209)	-0.177 (0.169)	-0.215 (0.179)
$\ln FUNCUP_{TH,t}$	0.009 (0.050)	0.002 (0.043)	n.a.	0.062 (0.067)	0.037 (0.058)	0.017 (0.062)
$\ln FUNCUP_{TH,t-1}$	0.151*** (0.046)	0.149*** (0.045)	n.a.	0.121** (0.060)	0.121** (0.055)	0.123** (0.057)
$SOCUP_{TH,t}$	0.021*** (0.002)	0.021*** (0.002)	n.a.	0.023*** (0.007)	0.011* (0.006)	0.011* (0.006)
Constant	19.730 (37.897)	n.a.	n.a.	-37.043 (44.776)	65.775** (28.910)	82.963** (32.967)
Observations	547	322	n.a.	322	239	239
R^2	n.a.	n.a.	n.a.	n.a.	0.2109	0.2363
χ^2	15,365.7***	8,483.5***	n.a.	309.33***	8,810.2***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	177.7***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-RE cannot generate the result because of a failure of statistical convergence.

Source: Author's calculations

Table 5-12 Thailand's Canned Tuna Exports to Developing Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	10.153 (13.628)	11.168 (13.555)	18.665 (23.401)	n.a.	-2.245 (7.831)	-624.341 (508.876)
$\ln GDP_{j,t}$	31.438* (16.693)	30.994* (17.768)	81.796*** (14.666)	n.a.	15.099** (5.825)	10.603 (7.443)
$\ln DIS_{THj}$	-0.780 (0.990)	n.a.	-1.598*** (0.426)	n.a.	-0.080 (0.229)	n.a.
$\ln PCGDP_{TH,t}$	-7.136 (14.882)	-8.174 (14.820)	-20.979 (25.653)	n.a.	6.238 (9.367)	627.398 (509.231)
$\ln PCGDP_{j,t}$	-30.433* (16.661)	-30.083* (17.764)	-81.144*** (14.670)	n.a.	-15.097*** (5.802)	-10.054 (7.436)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	622.778 (511.173)
$\ln POP_{j,t}$	-30.478* (16.831)	-30.366* (18.005)	-82.086*** (14.697)	n.a.	-15.119** (5.862)	-9.573 (7.574)
$BORDER_{THj}$	-4.448 (2.767)	n.a.	-0.708 (1.186)	n.a.	-0.928 (0.603)	n.a.
$TAGREE_{THj,t}$	0.732 (0.536)	0.718 (0.535)	-0.985** (0.484)	n.a.	0.047 (0.246)	0.298*** (0.094)
$GFCRISIS_t$	0.366*** (0.137)	0.347** (0.138)	-0.147 (0.334)	n.a.	0.198 (0.129)	0.150 (0.152)
$\ln RER_{THj,t}$	0.400 (0.284)	0.470* (0.265)	-0.027 (0.081)	n.a.	0.082 (0.050)	0.343*** (0.114)
$PRODUCTUP_{TH,t}$	0.023*** (0.009)	0.021** (0.008)	-0.006 (0.022)	n.a.	0.008 (0.008)	0.007 (0.010)
$\ln PROCESSUP_{TH,t}$	-0.395 (0.295)	-0.343 (0.292)	0.901 (0.690)	n.a.	-0.246 (0.202)	-0.214 (0.305)
$\ln PROCESSUP_{TH,t-1}$	-0.110 (0.183)	-0.090 (0.187)	0.199 (0.487)	n.a.	-0.029 (0.142)	-0.015 (0.159)
$\ln FUNCUP_{TH,t}$	-0.070 (0.060)	-0.062 (0.059)	0.111 (0.128)	n.a.	-0.069* (0.042)	-0.059 (0.046)
$\ln FUNCUP_{TH,t-1}$	0.028 (0.044)	0.024 (0.043)	-0.035 (0.105)	n.a.	0.048 (0.045)	0.032 (0.044)
$SOCUP_{TH,t}$	0.031*** (0.007)	0.031*** (0.007)	0.033** (0.014)	n.a.	0.017** (0.008)	0.015* (0.008)
Constant	-47.212 (54.514)	n.a.	-76.058 (93.142)	n.a.	7.125 (30.661)	1.057 (35.171)
Observations	2,047	373	2,047	n.a.	210	210
R^2	n.a.	n.a.	n.a.	n.a.	0.5572	0.6121
χ^2	644.17***	349.48***	255.73***	n.a.	156.76***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	675.41***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-FE cannot generate the result because of a failure of statistical convergence.

Source: Author's calculations

5.1.5 Canned Pineapple Exports

Tables 5-13 to 5-15 provide the results for Thai canned pineapple exports to the three trading partner groups: all countries, developed countries and developing countries. Table 5-13 shows that, estimated by the PPML method, only product upgrading is positively significant (at the 0.01 level) for Thai canned pineapple exports to all countries. This agrees with previous research that suggested that product upgrading is crucial to maintaining a country's position in GVCs (Humphrey & Schmitz, 2002; Knorringa & Pegler, 2006). Additionally, canned pineapple is a simple product with clear international forms: sliced, diced, chunks and solid packs. There are fewer concerns with food safety issues compared with other processed products (processed chicken, processed shrimp and canned tuna). This is because canned pineapple production does not involve transformation from raw to cooked food (Kohpaiboon, 2006; Wasusri et al., 2007). Other upgrading types seem to have less of an impact on Thai canned pineapple exports. For Thai canned pineapple exports to developed and developing countries (see Tables 5-14 and 5-15), the PPML estimates show that product upgrading is more significant than other upgrading types in Thai canned pineapple exports to these markets. Almost all of the alternative estimation methods support the PPML findings (see Tables 5-13 - 5-15). Although the PPML-FE estimates reveal that social upgrading is a positively significant (at the 0.1 level) variable for canned pineapple exports to developed countries, our finding lacks support from the other estimation methods (see Table 5-14).

In addition, all estimation methods reveal that the conventional variables, GDP and distance, are insignificant for exports of Thai canned pineapple (see Tables 5-13 - 5-15). The insignificance of both Thailand and trading partners' GDPs is a result of focusing on specific products or partners (Gebrehiwet et al., 2007; Mulapruk & Coxhead, 2005). Trade resistance resulting from the distance variable is irrelevant because of development in food technology and the nature of the canned food (Athukorala et al., 2002; Kohpaiboon, 2006).

The PPML estimates suggest that a common border is negatively significant (at the 0.01 level) for exports of Thai canned pineapple to all countries and developing countries (see Tables 5-13 and 5-15). The PPML-RE (PPML-FE) estimates indicate that trade agreements have a negative impact (at the 0.05 (0.1) significance level) on only for exports to developed-country markets (see Table 5-14). When trade agreements are fully implemented, countries tend to seek new business opportunities. Kohpaiboon and Jongwanich (2015) find that Thai exports under FTAs are dominated by the automotive sector, electric appliances and petrochemical products. These explain the trade agreement variable's negative coefficient. The PPML estimates show that the 2008 global financial crisis was positively significant for exports of canned pineapple to all countries and developed countries at the 0.05 and 0.01 levels, respectively (see Tables 5-13 and 5-14). The interpretation of this result is the same as the others

above. For the real exchange rate, the PPML estimates show that it is positively significant in Thai canned pineapple exports to all countries (at the 0.01 level), developed (at the 0.05 level) and developing countries (at the 0.1 level) (see Tables 5-13 - 5-15). This means that depreciation of the Thai baht leads to decreased export prices and, subsequently, to increased exports. This agrees with the fact that the canned pineapple traded in the world market is in simple forms. In short, price competitiveness is an important feature of export success (Kohpaiboon, 2006).

To investigate the robustness of the above PPML estimates, alternative estimation methods were used. These estimation methods support the PPML findings. For example, the NBPML and standard panel estimates indicate that the 2008 global financial crisis and the real exchange rate variables are positively significant for exports of Thai canned pineapple to all countries and developed countries (see Tables 5-13 and 5-14). The NBPML and tFEM estimates indicate that the real exchange rate is positively significant for Thai canned pineapple exports to developing countries (see Table 5-15).

Table 5-13 Thailand's Canned Pineapple Exports to all Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	7.675 (5.584)	6.726 (5.433)	7.398 (6.728)	n.a.	-8.437 (7.032)	-10.924 (382.758)
$\ln GDP_{j,t}$	-2.261 (3.048)	-2.358 (3.816)	-3.167 (3.496)	n.a.	1.126 (1.540)	-3.108 (2.129)
$\ln DIS_{THj}$	-1.724 (1.595)	n.a.	0.696 (0.482)	n.a.	-0.091 (0.295)	n.a.
$\ln PCGDP_{TH,t}$	-8.028 (7.473)	-7.513 (6.480)	-7.009 (7.470)	n.a.	9.909 (7.585)	10.866 (382.701)
$\ln PCGDP_{j,t}$	4.201 (3.911)	4.765 (3.940)	4.469 (3.498)	n.a.	-0.732 (1.511)	4.235* (2.264)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	4.171 (385.547)
$\ln POP_{j,t}$	4.505 (4.457)	5.914 (3.841)	4.767 (3.450)	n.a.	-0.552 (1.602)	5.441** (2.227)
$BORDER_{THj}$	-29.799*** (7.939)	n.a.	-20.110 (4305.593)	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	-0.082 (0.201)	-0.059 (0.170)	-0.209** (0.097)	n.a.	-0.016 (0.135)	0.012 (0.105)
$GFCRISIS_t$	0.191** (0.094)	0.192*** (0.059)	0.218*** (0.084)	n.a.	0.145 (0.088)	0.075 (0.100)
$\ln RER_{THj,t}$	0.348*** (0.092)	0.293*** (0.088)	0.443*** (0.069)	n.a.	0.115*** (0.042)	0.243*** (0.083)
$PRODUCTUP_{TH,t}$	0.018*** (0.007)	0.018*** (0.005)	0.021*** (0.006)	n.a.	0.015** (0.006)	0.011 (0.007)
$\ln PROCESSUP_{TH,t}$	-0.147 (0.135)	-0.175 (0.130)	-0.182 (0.172)	n.a.	0.047 (0.187)	0.109 (0.224)
$\ln PROCESSUP_{TH,t-1}$	-0.050 (0.136)	-0.050 (0.102)	-0.065 (0.124)	n.a.	0.072 (0.146)	0.128 (0.161)
$\ln FUNCUP_{TH,t}$	-0.018 (0.049)	-0.016 (0.035)	-0.020 (0.038)	n.a.	-0.037 (0.039)	-0.009 (0.041)
$\ln FUNCUP_{TH,t-1}$	-0.017 (0.032)	-0.012 (0.025)	-0.018 (0.032)	n.a.	-0.0001 (0.031)	-0.004 (0.029)
$SOCUP_{TH,t}$	0.005 (0.004)	0.005 (0.004)	0.005 (0.004)	n.a.	0.003 (0.003)	0.003 (0.004)
Constant	-36.236 (22.516)	n.a.	-36.211 (26.765)	n.a.	31.938 (28.255)	18.485 (30.015)
Observations	2,594	602	2,594	n.a.	481	481
R^2	n.a.	n.a.	n.a.	n.a.	0.1964	0.2758
χ^2	830.13***	197.07***	192.80***	n.a.	99.78***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	13.02***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-FE cannot generate the result because of a failure of statistical convergence.

Source: Author's calculations

Table 5-14 Thailand's Canned Pineapple Exports to Developed Countries

Regressors	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	1.337 (4.798)	-0.273 (4.77)	2.670 (7.750)	n.a.	-3.852 (6.904)	76.322 (403.692)
$\ln GDP_{j,t}$	34.132 (41.670)	-26.231 (22.349)	33.509 (44.879)	n.a.	80.232 (58.815)	49.838 (38.468)
$\ln DIS_{THj}$	-2.444 (11.690)	n.a.	-3.476 (2.396)	n.a.	0.294 (0.446)	n.a.
$\ln PCGDP_{TH,t}$	0.373 (5.271)	0.787 (5.600)	-1.274 (8.643)	n.a.	3.665 (7.187)	-77.454 (404.124)
$\ln PCGDP_{j,t}$	-34.094 (41.757)	27.348 (22.749)	-33.189 (44.873)	n.a.	-79.814 (58.848)	-48.879 (38.678)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	-80.226 (407.619)
$\ln POP_{j,t}$	-32.908 (42.945)	31.829 (23.383)	-32.325 (44.900)	n.a.	-79.625 (58.826)	-46.878 (38.644)
$BORDER_{THj}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	-0.282** (0.136)	-0.150* (0.088)	-0.275** (0.109)	n.a.	0.002 (0.209)	0.011 (0.177)
$GFCRISIS_t$	0.270*** (0.081)	0.256*** (0.066)	0.264*** (0.095)	n.a.	0.158 (0.101)	0.118 (0.134)
$\ln RER_{THj,t}$	0.359 (0.353)	0.279** (0.114)	0.389*** (0.101)	n.a.	0.146*** (0.035)	0.185 (0.149)
$PRODUCTUP_{TH,t}$	0.018*** (0.004)	0.017*** (0.004)	0.018*** (0.007)	n.a.	0.015** (0.007)	0.013 (0.009)
$\ln PROCESSUP_{TH,t}$	-0.138 (0.124)	-0.181 (0.114)	-0.142 (0.192)	n.a.	0.012 (0.181)	0.066 (0.278)
$\ln PROCESSUP_{TH,t-1}$	-0.082 (0.133)	-0.065 (0.095)	-0.080 (0.141)	n.a.	0.133 (0.165)	0.158 (0.191)
$\ln FUNCUP_{TH,t}$	-0.036 (0.043)	-0.029 (0.031)	-0.031 (0.044)	n.a.	-0.006 (0.038)	0.011 (0.044)
$\ln FUNCUP_{TH,t-1}$	-0.033 (0.035)	-0.018 (0.022)	-0.034 (0.036)	n.a.	0.016 (0.041)	0.017 (0.038)
$SOCUP_{TH,t}$	0.007 (0.004)	0.009* (0.005)	0.008 (0.005)	n.a.	0.004 (0.004)	0.005 (0.004)
Constant	-3.791 (28.865)	n.a.	-5.093 (31.335)	n.a.	13.922 (28.083)	6.889 (32.898)
Observations	547	350	547	n.a.	291	291
R^2	n.a.	n.a.	n.a.	n.a.	0.2230	0.2615
χ^2	1,2430.8***	647.17***	78.73***	n.a.	218.09**	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	9.50***

Note: 1. *, **, *** indicate statistically significan at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-FE cannot generate the result because of a failure of statistical convergence.

Source: Author's calculations

Table 5-15 Thailand's Canned Pineapple Exports to Developing Countries

Regressor	Estimation Method					
	PPML-RE	PPML-FE	NBPML-RE	NBPML-FE	REM	FEM
$\ln GDP_{TH,t}$	6.189 (18.220)	8.789 (16.360)	9.744 (15.370)	n.a.	-14.296 (15.896)	-335.968 (738.813)
$\ln GDP_{j,t}$	-2.501 (3.672)	-2.927 (3.912)	-3.360 (3.411)	n.a.	1.829 (3.347)	-3.006 (2.472)
$\ln DIS_{THj}$	-2.410 (4.129)	n.a.	1.185* (0.678)	n.a.	-0.121 (0.196)	n.a.
$\ln PCGDP_{TH,t}$	-3.713 (21.850)	-7.204 (18.457)	-6.701 (17.140)	n.a.	18.720 (17.446)	338.077 (738.327)
$\ln PCGDP_{j,t}$	4.843 (4.632)	5.626 (3.931)	4.624 (3.419)	n.a.	-1.666 (3.366)	4.208 (2.608)
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	322.769 (740.820)
$\ln POP_{j,t}$	5.423 (4.235)	5.997 (3.909)	5.097 (3.434)	n.a.	-1.609 (3.389)	5.255* (2.533)
$BORDER_{THj}$	-29.431*** (11.332)	n.a.	-17.495 (1227.641)	n.a.	n.a.	n.a.
$TAGREE_{THj,t}$	0.191 (0.436)	0.137 (0.373)	-0.074 (0.205)	n.a.	-0.107 (0.106)	-0.050 (0.095)
$GFCRISIS_t$	0.321 (0.286)	0.269 (0.178)	0.321 (0.206)	n.a.	0.199 (0.161)	0.063 (0.156)
$\ln RER_{THj,t}$	0.302 (0.268)	0.365* (0.199)	0.508*** (0.101)	n.a.	0.026 (0.047)	0.265* (0.131)
$PRODUCTUP_{TH,t}$	0.043** (0.021)	0.040*** (0.015)	0.047*** (0.014)	n.a.	0.021* (0.011)	0.012 (0.010)
$\ln PROCESSUP_{TH,t}$	-0.522 (0.633)	-0.457 (0.563)	-0.547 (0.432)	n.a.	-0.075 (0.458)	0.039 (0.438)
$\ln PROCESSUP_{TH,t-1}$	-0.342 (0.282)	-0.307 (0.260)	-0.306 (0.288)	n.a.	-0.063 (0.254)	0.049 (0.289)
$\ln FUNCUP_{TH,t}$	-0.091 (0.103)	-0.078 (0.091)	-0.070 (0.084)	n.a.	-0.084 (0.083)	-0.055 (0.083)
$\ln FUNCUP_{TH,t-1}$	0.005 (0.103)	-0.004 (0.087)	0.017 (0.075)	n.a.	0.002 (0.063)	-0.013 (0.054)
$SOCUP_{TH,t}$	-0.003 (0.010)	-0.005 (0.008)	-0.005 (0.010)	n.a.	0.004 (0.005)	-0.0002 (0.006)
Constant	-33.510 (68.953)	n.a.	-48.560 (61.189)	n.a.	54.784 (63.191)	43.076 (53.656)
Observations	2,047	252	2,047	n.a.	190	190
R^2	n.a.	n.a.	n.a.	n.a.	0.1779	0.3235
χ^2	767.32***	265.7***	151.62***	n.a.	131.02***	n.a.
F-Stat	n.a.	n.a.	n.a.	n.a.	n.a.	107.06***

Note: 1. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
2. Numbers in parentheses are corrected standard errors.
3. The dummy variable $ASCRISIS_t$ is automatically omitted because of collinearity problems.
4. The reported coefficient can be illustrated as elasticity, except the coefficients of product and social upgrading. These coefficients can be elaborated as semi-elasticity, (the formula is b_i*100). The formula to compute elasticity of the dummy variable is $\left(e^{b_i}-1\right)$*100%, where b_i is the coefficient of the dummy variable (Gujarati & Porter, 2005; Santos Silva & Tenreyro, 2006).
5. The NBPML-FE cannot generate results because of a failure of statistical convergence.

Source: Author's calculations

5.2 A Discussion of the Empirical Results of the Economic and Social Upgrading Impacts on Thai Processed Food Exports

The results presented in Tables 5-1 - 5-15 are mixed regarding the impact of economic and social upgrading on TPFEs. The results depend on the characteristics of the Thai export products and of the trading partners. This section discusses and simplifies the results. There is also a discussion of the results for other regressors used in the gravity model. The PPML estimates are used in the discussion. Tables 5-1 - 5-15 show the PPML estimates can deal with the gravity model and provide robust and superior results to other methods, namely NBPML, REM and FEM.

Various upgrading types are important to TPFEs. Product upgrading is positively significant for exports of all product categories (total processed food, processed shrimp, processed chicken, canned tuna, and canned pineapple). For example, for total processed food exports to all countries, the results show that the product upgrading variable is significant at the 0.05 level. Its estimated semi-elasticity value is 0.01. This means that a shift in product upgrading by 1 unit will increase total processed food exports to all countries by 1% (see Table 5-16).

The process upgrading variable is negatively significant for TPFEs. However, the process upgrading lagged variable is positively significant. For processed shrimp exports to developed countries, the process upgrading variable is negatively significant at the 0.05 level. Its estimated elasticity value is -0.43. This means that a 1% increase in process upgrading will cause the exports to reduce by 0.43%. In contrast, the process upgrading lagged variable is positively significant at the 0.05 level. Its estimated elasticity values are 0.64 and 0.65 regressed by PPML-RE and PPML-FE, respectively. This means that if the process upgrading lagged variable increases by 1%, exports will increase by around 0.64% - 0.65% (see Table 5-16).

The results show that both functional upgrading and its lagged variable are positively significant in TPFEs (see Table 5-16). This is the result of an increase in distribution channels through the acquisition of global brands, especially for fish in developed countries (Kohpaiboon, 2006; Kuldilok, 2009; Thai Union Group Public Company Limited, 2016). For example, both functional upgrading and its lagged variable positively impact processed shrimp exports to developed countries at the 0.01 significance level. Their estimated elasticity values are 0.34 and 0.32, respectively. This means that a 1% increase in the functional upgrading (lagged) variable shifts these exports by 0.34% (0.32%).

Table 5-16 shows that social upgrading is positively significant for most TPFEs, especially exports to developed countries. Some empirical studies state that developed countries pay more attention to labour standards (employment and wages), than developing countries that focus only on product price

and quality (Dolan & Tewari, 2001; Lee & Gereffi, 2014; The Office of Industrial Economics, 2015; Singh, 2013). For example, social upgrading positively impacts processed shrimp and canned tuna exports to developed countries at the 0.05 and 0.01 significance levels. Table 5-16 shows an increase in the social upgrading variable by 1 unit will cause processed shrimp and canned tuna exports to increase by 1.5% and 2.1%, respectively. With respect to exports to developing countries, social upgrading is significant only for Thai canned tuna exports to them, with an estimated coefficient of 0.031 (see Table 5-16). This means that a 1 unit increase in the social upgrading variable will lead to an increase in Thai canned tuna exports to developing countries by 3.1%

More interestingly, when we compare the impact of economic and social upgrading on TPFEs to developed countries with exports to developing countries, the results show that all upgrading types are statistically significant for TPFEs to developed countries. By contrast, most upgrading types are insignificant in those exports to developing countries. These results support previous research that states that developed countries are more concerned about product quality, food safety issues and labour standards than developing countries (Baylis et al., 2010; Dolan & Tewari, 2001; Jongwanich, 2009; Lee & Gereffi, 2014). Moreover, if processed food products are classified as having a simple form in international standards, the results suggest that economic and social upgrading are rarely significant for exporting those products to global markets. The results in Table 5-16 show only product upgrading is significant for Thai canned pineapple exports. Compared with other export products with more complex production processes (such as processed shrimp and processed chicken), all upgrading types are significant for their exports. This is because there are various product standards that producers and exporters must meet and these vary depending on the importer (Buzby 2001; Fromm, 2007; Kohpaiboon, 2006; Ponte, 2002). As a result, we can infer that the use of upgrading types to enhance TPFEs depends on Thailand's trading partners' and export products' characteristics. In short, it is impossible to provide a 'one size fits all' policy that would encompass the needs of both developed and developing countries and various products.

Table 5-16 shows there is not much difference between the PPML-RE and PPML-FE estimates; the coefficients reported by these two methods are fairly similar. This suggests that the results are robust when applied to the gravity model.

Table 5-16 A Comparison of the Results: The Impact of Upgrading Variables on TPFEs

Export Product	All Countries		Developed Countries		Developing Countries	
to Partners	PPML-RE	PPML-FE	PPML-RE	PPML-FE	PPML-RE	PPML-FE
Total Processed Food						
$PRODUCTUP_{TH,t}$	0.010**	0.010**	0.009*	0.010**	0.016	0.016
$lnPROCESSUP_{TH,t}$	-0.153*	-0.153*	-0.036	-0.034	-0.394	-0.396
$lnPROCESSUP_{TH,t-1}$	0.126**	0.125**	0.206**	0.210**	0.168	0.168
$lnFUNCUP_{TH,t}$	0.055**	0.054**	0.090***	0.090***	0.021	0.021
$lnFUNCUP_{TH,t-1}$	0.044	0.044	0.059**	0.060**	0.074	0.075
$SOCUP_{TH,t}$	0.008**	0.008**	0.008***	0.008***	0.005	0.005
Processed Shrimp						
$PRODUCTUP_{TH,t}$	0.025***	0.025***	0.028***	0.028***	-0.004	-0.007
$lnPROCESSUP_{TH,t}$	-0.351***	-0.346***	-0.434**	-0.433**	0.549	0.632
$lnPROCESSUP_{TH,t-1}$	0.513***	0.526***	0.644**	0.647**	-0.592	-0.557
$lnFUNCUP_{TH,t}$	0.285***	0.288***	0.336***	0.336***	-0.118	-0.108
$lnFUNCUP_{TH,t-1}$	0.240***	0.242***	0.317***	0.318***	-0.428*	-0.436**
$SOCUP_{TH,t}$	0.015**	0.015**	0.015**	0.015**	0.008	0.008
Processed Chicken						
$PRODUCTUP_{TH,t}$	0.024***	0.025***	0.029***	0.031***	0.017	0.022**
$lnPROCESSUP_{TH,t}$	-0.713***	-0.713***	-0.767***	-0.765***	0.267	0.172
$lnPROCESSUP_{TH,t-1}$	-0.068	-0.099	-0.089	-0.091	0.267	0.183
$lnFUNCUP_{TH,t}$	0.017	0.003	-0.001	-0.011	-0.057	-0.099
$lnFUNCUP_{TH,t-1}$	0.119**	0.113***	0.122***	0.122**	0.065	0.067
$SOCUP_{TH,t}$	0.005**	0.004***	0.004	0.004***	-0.002	-0.002
Canned Tuna						
$PRODUCTUP_{TH,t}$	0.018***	0.019***	0.022***	0.022***	0.023***	0.021**
$lnPROCESSUP_{TH,t}$	-0.553***	-0.565***	-0.612***	-0.620***	-0.395	-0.343
$lnPROCESSUP_{TH,t-1}$	-0.105	-0.110	-0.185	-0.201	-0.110	-0.090
$lnFUNCUP_{TH,t}$	-0.001	-0.003	0.009	0.002	-0.070	-0.062
$lnFUNCUP_{TH,t-1}$	0.118	0.119***	0.151***	0.149***	0.028	0.024
$SOCUP_{TH,t}$	0.025***	0.025***	0.021***	0.021***	0.031***	0.031***
Canned Pineapple						
$PRODUCTUP_{TH,t}$	0.018***	0.018***	0.018***	0.017***	0.043**	0.040***
$lnPROCESSUP_{TH,t}$	-0.147	-0.175	-0.138	-0.181	-0.522	-0.457
$lnPROCESSUP_{TH,t-1}$	-0.050	-0.050	-0.082	-0.065	-0.342	-0.307
$lnFUNCUP_{TH,t}$	-0.018	-0.016	-0.036	-0.029	-0.091	-0.078
$lnFUNCUP_{TH,t-1}$	-0.017	-0.012	-0.033	-0.018	0.005	-0.004
$SOCUP_{TH,t}$	0.005	0.005	0.007	0.009*	-0.003	-0.005

Note: 1. The reported coefficient is regressed using PPML.
2. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
Source: Author's summarisation from Tables 5-1 to 5-15

This study finds that the GDPs of Thailand and its trading partners can be either significant or insignificant for TPFEs. Previous scholars have noted that the insignificance of GDP often occurs when studies focus either on specific products or specific partners, or both (Gebrehiwet et al., 2007; Kareem, 2013; Mulapruk & Coxhead, 2005). Table 5-17 shows GDP is significant only for total processed food and processed shrimp exports. Compared with other products, both Thailand's and its trading partners' GDPs are frequently insignificant. The distance variable is also insignificant. This is because of changes in food technology and the nature of canned foods (non-perishable and hence can travel long distances) (Athukorala et al., 2002). These attributes can reduce trade resistance caused by geographic distance.

For processed food exports to developed countries, both Thailand and its trading partners' GDPs are positively significant. In contrast, there is a negative relationship for exports to developing countries. Previous studies have shown that this is directly related to the size of Thailand's trading partners' economies; when they are smaller, they tend to rely more on international trade (Gebrehiwet et al., 2007; Mulapruk & Coxhead, 2005). Most coefficients' signs of the distance variable are negative, as expected, with the exception of exports of Thai processed shrimp to developed countries, which is positively significant. This could be related to developments in food technology and the logistics between Thailand and its trading partners.

Table 5-17 shows that the coefficients reported by the PPML-RE are not much different from the coefficients reported by PPML-FE technique. The key difference between these two estimation techniques is that the distance variable is dropped in the case of the PPML-FE estimation. This is because time-invariant variables are dropped when using the PPML estimation with fixed effects (Cameron & Trivedi, 2009; Prehn et al., 2016).

Table 5-17 A Comparison of the Results: The Impact of Conventional Variables on TPFEs

Export Product to Partners	All Countries		Developed Countries		Developing Countries	
	PPML-RE	PPML-FE	PPML-RE	PPML-FE	PPML-RE	PPML-FE
Total Processed Food						
$\ln GDP_{TH,t}$	9.758	9.757	12.596***	12.67***	-9.87	-10.039
$\ln GDP_{j,t}$	-8.263***	-8.281***	92.139*	96.621**	-8.75***	-8.741***
$\ln DIS_{THj}$	-1.713***	n.a.	-0.629	n.a.	-1.482	n.a.
Processed Shrimp						
$\ln GDP_{TH,t}$	28.068***	28.972***	34.151***	34.214***	-45.116***	-39.272***
$\ln GDP_{j,t}$	-39.347	-37.809	317.189***	324.704***	-292.405**	-307.472***
$\ln DIS_{THj}$	-5.941	n.a.	4.234***	n.a.	-7.147***	n.a.
Processed Chicken						
$\ln GDP_{TH,t}$	17.156	14.357*	14.73	11.709**	-82.964**	-82.868**
$\ln GDP_{j,t}$	89.376	72.939	38.622	5.260	-321.243**	-305.797***
$\ln DIS_{THj}$	-1.437**	n.a.	-6.355	n.a.	-26.694	n.a.
Canned Tuna						
$\ln GDP_{TH,t}$	1.917	1.463	-4.063	-5.166	10.153	11.168
$\ln GDP_{j,t}$	15.267	16.230	52.042**	54.438**	31.438*	30.994*
$\ln DIS_{THj}$	-0.774	n.a.	-0.426	n.a.	-0.78	n.a.
Canned Pineapple						
$\ln GDP_{TH,t}$	7.675	6.726	1.337	-0.273	6.189	8.789
$\ln GDP_{j,t}$	-2.261	-2.358	34.132	-26.231	-2.501	-2.927
$\ln DIS_{THj}$	-1.724	n.a.	-2.444	n.a.	-2.410	n.a.

Note: 1. The reported coefficient is regressed using PPML.
2. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
Source: Author's summarisations from Tables 5-1 to 5-15

According to the literature, control variables such as export countries' GDP per capita are commonly used as a proxy for a country's capital-labour ratio. Table 5-18 shows that TPFEs are both labour-intensive and capital-intensive products, depending on Thailand's trading partners. That is, if processed food products are exported to developed countries, the products are usually characterised as labour-intensive products. For instance, Thai GDP per capita is negative and statistically significant

with respect to total processed food and processed shrimp exports to developed countries. In contrast, the positive significance of Thai GDP per capita to Thai processed food exports is found for processed shrimp and processed chicken exports to developing countries (see Table 5-18).

With regard to Thailand's trading partners' GDP per capita, if the coefficient is positive (negative), it means that export products are classified as luxury (necessity) goods (Bergstrand, 1989; Egger, 2002; Schumacher, 2003). As Table 5-18 demonstrates, TPFEs are classified as both luxury and necessity goods; it depends on exporting destinations and product characteristics. That is, processed food exports to developed countries are mainly characterised as necessities, but the products exported to developing countries are classified as luxury goods. Although Thailand's trading partners' GDP per capita is negatively significant (at the 0.1 level) for canned tuna exports to developing countries, this may be the result of particular characteristics of Thai canned tuna export products; the products are in simple form (i.e., tuna in water or oil).

The Thai population variable is dropped because of a collinearity problem. Conversely, Thailand's trading partners' population exhibits both positive and negative impacts on TPFEs (see Table 5-18). For processed food exports to developed countries, the coefficient is negative; increasing population may denote larger resource endowment, a larger domestic market or greater self-sufficiency. This leads to less reliance on international trade. For exports to developing countries, the results show that developing countries' increasing population leads to a shift in TPFEs (see Table 5-18).

The common border variable is insignificant for TPFEs. This is because the major exporting markets for Thai processed food are developed countries, the U.S., Japan, and the EU. Moreover, developments in processed food technology and transport help extend shelf life. Thus, processed food products can be distributed around the world.

Table 5-18 illustrates that the trade agreement variable can be positively significant, negatively significant or insignificant for TPFEs. Positive significance of this variable is usually found for processed food exports to developing countries, i.e., total processed food exports, and processed chicken exports. In contrast, for processed food exports to developed countries, the results show a negative coefficient. The main reason is the emergence of new food regulations that can be difficult for Thailand to meet (Jongwattanakul, 2012; Kohpaiboon & Jongwanich, 2015). The insignificance of trade agreements for exports indicates that when trade agreements are fully implemented, countries can seek new business opportunities to export new products. Kohpaiboon and Jongwanich (2015) find that Thai product exports under FTAs are usually dominated by the automotive sector, electric appliances and petrochemical products.

The 2008 global financial crisis variable is either positively significant or insignificant for TPFEs. This may be because the crisis effect was felt primarily between the last quarter of 2008 and the first half of 2009. In the last quarter of 2009, the trade environment recovered and that subsequently led to an increase in Thai exports (Jongwattanakul, 2012). As a result, this variable can be positively significant or insignificant for TPFEs (see Table 5-18).

Table 5-18 shows that the real exchange rate is positively significant for TPFEs. Depreciation of the Thai baht leads to a reduction in Thai export prices and, subsequently, to the expansion of exports. However, the real exchange rate variable can be negatively significant for TPFEs. For the total processed food exports to developing countries, this variable is negatively significant at the 0.05 level. This is because Thailand mainly exports those products to ASEAN countries, most of which are categorised as developing nations. In addition, intra-trade in ASEAN usually uses U.S. dollar and Thai bath as trade currencies (Bank of Thailand, 2017). As a result, an increase in trade within ASEAN can lead to appreciation of the Thai baht.

Table 5-18 A Comparison of the Results: The Impact of Other Control Variables on TPFEs

Export Product to Partners	All Countries		Developed Countries		Developing Countries	
	PPML-RE	PPML-FE	PPML-RE	PPML-FE	PPML-RE	PPML-FE
Total Processed Food						
$\ln PCGDP_{TH,t}$	-12.821	-12.817	-16.157**	-16.218**	8.503	8.673
$\ln PCGDP_{j,t}$	9.777***	9.791***	-90.874*	-95.379**	10.917***	10.913***
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\ln POP_{j,t}$	10.293***	10.313***	-92.303*	-96.984**	12.484***	12.521***
$BORDER_{THj}$	1.879	n.a.	n.a.	n.a.	3.471	n.a.
$TAGREE_{THj,t}$	0.165	0.165	-0.062	-0.072	0.386***	0.387**
$GFCRISIS_t$	0.027	0.027	0.013	0.013	0.119	0.119
$\ln RER_{THj,t}$	-0.062	-0.063	0.105	0.111	-0.058**	-0.059**
Processed Shrimp						
$\ln PCGDP_{TH,t}$	-38.63***	-39.609***	-46.28***	-46.27***	52.863***	46.671***
$\ln PCGDP_{j,t}$	41.926	40.399	-314.88***	-322.47***	295.861**	310.78***
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\ln POP_{j,t}$	36.044	33.829	-323.954***	-331.76***	295.045***	307.151***
$BORDER_{THj}$	-19.766	n.a.	n.a.	n.a.	-6.164	n.a.
$TAGREE_{THj,t}$	-0.115	-0.143	-0.335**	-0.351***	0.191	0.178
$GFCRISIS_t$	-0.044	-0.047	-0.071	-0.070	0.122	0.077
$\ln RER_{THj,t}$	0.286	0.298	0.267	0.276	-0.348	-0.276
Processed Chicken						
$\ln PCGDP_{TH,t}$	-16.046	-12.345	-12.027	-8.052	95.307**	97.391**
$\ln PCGDP_{j,t}$	-88.504	-72.638	-39.057	-6.348	319.794**	302.875***
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\ln POP_{j,t}$	-87.767	-71.363	-40.522	-8.348	329.752***	314.444***
$BORDER_{THj}$	-25.368***	n.a.	n.a.	n.a.	-97.069	n.a.
$TAGREE_{THj,t}$	0.161	0.160	-0.012	-0.065	1.016***	0.988***
$GFCRISIS_t$	0.397***	0.416***	0.480***	0.505***	0.211	0.229
$\ln RER_{THj,t}$	0.292***	0.295***	0.258***	0.257***	-0.314	0.467
Canned Tuna						
$\ln PCGDP_{TH,t}$	-1.649	-1.154	5.892	7.403	-7.136	-8.174
$\ln PCGDP_{j,t}$	-13.958	-14.932	-53.236**	-55.953**	-30.433*	-30.083*
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\ln POP_{j,t}$	-12.581	-13.382	-50.519**	-52.881**	-30.478*	-30.366*
$BORDER_{THj}$	-5.313*	n.a.	n.a.	n.a.	-4.448	n.a.
$TAGREE_{THj,t}$	0.172	0.182	0.095	0.094	0.732	0.718
$GFCRISIS_t$	0.276***	0.282***	0.313***	0.326***	0.366***	0.347**
$\ln RER_{THj,t}$	0.120	0.099	0.112	0.106	0.400	0.470*
Canned Pineapple						
$\ln PCGDP_{TH,t}$	-8.028	-7.513	0.373	0.787	-3.173	-7.204
$\ln PCGDP_{j,t}$	4.201	4.765	-34.094	27.348	4.843	5.626
$\ln POP_{TH,t}$	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
$\ln POP_{j,t}$	4.505	5.914	-32.908	31.829	5.423	5.997
$BORDER_{THj}$	-29.799***	n.a.	n.a.	n.a.	-29.431***	n.a.
$TAGREE_{THj,t}$	-0.082	-0.059	-0.282**	-0.150*	0.191	0.137
$GFCRISIS_t$	0.191**	0.192***	0.270***	0.256***	0.321	0.269
$\ln RER_{THj,t}$	0.348***	0.293***	0.359	0.279**	0.302	0.365*

Note: 1. The reported coefficient is regressed using PPML.

2. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.

3. $ASCRISIS_t$ is not presented because these variables are not reported in Tables 5-1 – 5-15.

Source: Author's summarisation from Tables 5-1 to 5-15

5.3 Determinants Influencing Economic and Social Upgrading of the Thai Processed Food Sector

5.3.1 The Determinants Influencing Product Upgrading

Table 5-19 shows the determinants that impact product upgrading in the TPFS over the study period. After using various data conversion techniques and OLS estimation, Table 5-19 shows that the most appropriate result is model (2). It gives the lowest RMSE value compared with the other models. The calculated R-square is 54.3%.

The results from model (2) show R&D is an insignificant variable.[25] Only the human development variable is positively significant in product upgrading (at the 0.1 level), with respect to the variable group related to productive capacity. This agrees with the fact that the most important requirement for producing Thai processed foods for export is the need for a great number of skilled labourers (Kohpaiboon, 2006; The Office of Industrial Economics, 2015). The results show that both variables (port performance and access to the internet) in relation to infrastructure and services are insignificant for product upgrading in the Thai processed food industry. The business environment and political stability are positively significant at the 0.01 level for product upgrading. This result indicates that political stability leads to an increase in investors' and exporters' confidence and hence to an upgrading (World Bank, 2018).

Financial support is negatively significant at the 0.1 level in product upgrading. Previous research has indicated that this is possibly because financial development decreases liquidity constraints which can facilitate export diversification (Manova, 2013; Wamboye & Mookerjee, 2013). Exporters may seek new opportunities to export new products with fewer standards than processed food. The results show that the trade openness index proxied for trade policy is insignificant in product upgrading. Trade policies favoured in international trade (exports and imports) can have a positive impact on both the specialisation and diversification of exports (Makhlouf et al., 2015). An increase in the level of trade openness can lead to a shift in export opportunities. This enables exporters to diversify their exports and leads to a decrease in exporters' desires to upgrade their existing export products. It is possible that trade openness is insignificant for Thai the processed food industry product upgrading. Table 5-19 shows that the presence of the Thai Central Laboratory is positively significant at the 0.01 level in product upgrading. This is because the laboratory was established through collaboration between the government and private sector. The laboratory assists local exporters to meet global product

[25] According to the product upgrading calculations, product prices and export share are usually determined by global buyers (Thailand's Office of Agricultural Affairs, 2016). This means that exporters cannot establish product prices and market share even though an increase in domestic R&D emerges.

standards. This finding concurs with previous qualitative research that reported that good collaboration between the government and the private sector supports upgrading in GVCs (Bamber et al., 2014; Kowalski et al., 2015)

Table 5-19 The Determinants Influencing Product Upgrading

Dependent Variable: Product upgrading

Regressors	Model							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnRD	-2.12	-0.53	1.98	-10.14*	-9.48**	-18.11***	-5.00	-1.25
	(4.98)	(1.25)	(3.95)	(5.08)	(3.58)	(4.69)	(4.25)	(1.06)
lnHD	38.81**	9.70*	19.63	-19.94	26.33*	13.66	28.64*	7.16*
	(14.73)	(3.68)	(24.42)	(25.08)	(14.75)	(17.52)	(14.48)	(3.62)
lnPORT	36.19	9.05	-4.68	-62.90**	2.22	-28.17	23.40	5.85
	(28.83)	(7.21)	(21.97)	(26.39)	(16.52)	(24.99)	(21.98)	(5.49)
lnINT	-14.51	-3.63	-5.02	25.92**	2.28	18.96*	-7.41	-1.85
	(12.50)	(3.12)	(9.88)	(12.80)	(6.76)	(11.09)	(9.48)	(2.37)
PS	9.64***	9.64***	-10.31	-20.05***	10.5***	11.45***	9.75***	9.75***
	(1.57)	(1.57)	(7.23)	(7.32)	(1.72)	(1.94)	(1.58)	(1.58)
lnFINSUP	-23.95*	-5.99*	-13.62	19.72	-9.24	10.57	-16.63	-4.16
	(13.48)	(3.37)	(13.08)	(14.63)	(8.31)	(12.15)	(11.44)	(2.86)
lnTOPEN	-22.36	-5.59	0.81	62.48**	15.78	49.59**	-9.35	-2.34
	(25.48)	(6.37)	(20.71)	(27.67)	(13.22)	(22.43)	(19.09)	(4.77)
LAB	11.92***	2.98***	6.75***	-5.76	6.09***	-1.34	9.73***	2.43***
	(3.95)	(0.99)	(2.50)	(5.38)	(1.29)	(3.26)	(3.26)	(0.81)
Constant	-57.21	-10.14	11.20	3.42	-79.01*	-129.9***	-55.15	-9.06
	(46.43)	(6.78)	(61.62)	(61.50)	(42.94)	(42.63)	(48.24)	(7.39)
Obs.	64	64	61	61	61	61	64	64
F-Stat	10.88***	10.88***	4.18***	3.69***	10.75***	6.08***	7.59***	7.59***
R^2	0.5430	0.5430	0.3464	0.3032	0.6155	0.5456	0.5139	0.5140
RMSE	3.0066	0.7517	3.5148	3.629	2.3858	2.5935	3.1887	0.7971

Note: 1. Models (1) - (8) are OLS regression results after comverting annual data to quarterly data. (1) is a constant-average method, (2) is a constant-sum method, (3) is a cubic-first method, (4) is a cubic-last method, (5) is a linear-first method, (6) is a linear-last method, (7) is a quadratic-average method, and (8) is a quadratic-sum method.
2. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
3. Numbers in parentheses are corrected standard errors.

Source: Author's calculations

5.3.2 The Determinants Influencing Process Upgrading

Table 5-20 shows the key determinants' impacts on process upgrading of TPFS. Model (5) in Table 5-20 reports the lowest RMSE value; the R-square of model (5) is higher than for other models. Model (5), Table 5-20, shows the factors related to productive capacity are significant for the process upgrading. Human development is a positively significant variable at the 0.01 level. This is because, to comply with multiple product standards (such as packaging and processing), skilled labourers are needed (Bamber et al., 2014; OECD et al., 2014). In contrast, R&D is an insignificant variable. The determinants related to infrastructure and service are also considered. Port performance is positively significant (at the 0.01 level) for Thai processed food industry process upgrading. This is because more developed transport especially port infrastructure, results in lower transport costs because the system can handle greater volume of product. Port infrastructure development assists exporters to manage and keep their export products' high quality (Bamber et al., 2014; OECD et al., 2014; Rodrigue et al.,

2009). By contrast, access to the internet is negatively significant (at the 0.1 level) for process upgrading. Clarke and Wallsten (2006) state that internet development can help exporters access new information and reduce the entry costs into new markets. As a result, exporters can seek new trading partners with less strict standards and diversify their exports to new trading partners and existing ones. As a result, exporters are likely to reduce process upgrading activities required for continuing export to destinations with stringent product standards. For the business environment, political stability, which is proxy for the business environment, is positively significant (at the 0.01 level) for process upgrading. This is because political stability encourages private firms to invest in and develop parts of their production processes, particularly human resources (Feng, 2001). This situation can lead to an increase in process upgrading. On the other hand, access to financial support is insignificant for the process upgrading. Trade openness is negatively significant (at the 0.01 level) for the Thai processed food industry process upgrading. In short, more reliance on international trade leads to a decrease in process upgrading. Authors have argued that if countries increase their reliance on international trade, they tend to diversify their exports (Ali, 2017; Makhlouf et al., 2015). It is possible that countries can diversify their exports by selling to new partners who have less strict product standards, instead of selling to existing trading partners. Table 5-20 illustrates that the presence of the analytical laboratory is a positively significant variable (at the 0.01 level) for the process upgrading. The laboratory was established through collaboration between the government and the private sector and provides a space where producers can have their products tested to ensure they meet food safety standards. This result implies that collaboration between the government and private firms is important for process upgrading.

Table 5-20 The Determinants Influencing Process Upgrading

Dependent Variable: Process upgrading

Regressors	Model							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnRD	0.58*	0.58*	0.16	-0.31	0.05	-0.26	0.25	0.25
	(0.31)	(0.31)	(0.17)	(0.24)	(0.19)	(0.25)	(0.25)	(0.25)
lnHD	3.40***	3.39***	0.50	-0.21	2.38***	2.64***	2.69***	2.69***
	(0.90)	(0.90)	(0.10)	(1.15)	(0.85)	(0.94)	(0.77)	(0.77)
lnPORT	5.08***	5.07***	1.52**	-0.57	2.74***	1.74	3.47***	3.47***
	(1.14)	(1.14)	(0.69)	(1.00)	(0.83)	(1.14)	(0.93)	(0.93)
lnINT	-1.99***	-1.99***	-0.40	0.98*	-0.57*	0.21	-1.05**	-1.05**
	(0.60)	(0.60)	(0.35)	(0.56)	(0.32)	(0.54)	(0.47)	(0.47)
PS	0.13**	0.52**	-0.72**	-1.04***	0.21***	0.28***	0.16***	0.62***
	(0.05)	(0.20)	(0.35)	(0.33)	(0.06)	(0.07)	(0.05)	(0.21)
lnFINSUP	-1.43*	-1.43*	0.39	1.00	-0.63	-0.51	-0.82	-0.82
	(0.75)	(0.75)	(0.55)	(0.64)	(0.64)	(0.76)	(0.65)	(0.65)
lnTOPEN	-4.50***	-4.50***	-1.40**	0.67	-2.28***	-1.32	-2.99***	-2.99***
	(1.02)	(1.02)	(0.64)	(1.01)	(0.77)	(1.12)	(0.84)	(0.84)
LAB	0.78***	0.78***	0.43***	-0.23	0.34***	-0.06	0.46**	0.46**
	(0.17)	(0.17)	(0.09)	(0.20)	(0.08)	(0.14)	(0.18)	(0.18)
Constant	-4.91**	-4.71***	-1.48	-2.36	-5.47**	-7.76***	-5.39**	-4.63**
	(2.42)	(1.72)	(2.15)	(2.67)	(2.05)	(2.17)	(2.58)	(1.84)
Obs.	56	56	53	53	53	53	56	56
F-Stat	734.2***	734.7***	110.0***	71.42***	400.5***	227.5***	173.1***	173.3***
R^2	0.9036	0.9035	0.9244	0.8995	0.9474	0.9298	0.8843	0.8843
RMSE	0.1309	0.1309	0.1138	0.1313	0.0926	0.1070	0.1446	0.1446

Note: 1. Models (1) - (8) are OLS regression results after comverting annual data to quarterly data. (1) is a constant-average method, (2) is a constant-sum method, (3) is a cubic-first method, (4) is a cubic-last method, (5) is a linear-first method, (6) is a linear-last method, (7) is a quadratic-average method, and (8) is a quadratic-sum method.

2. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.

3. Numbers in parentheses are corrected standard errors.

Source: Author's calculations

5.3.3 The Determinants Influencing Functional Upgrading

Significant determinants affecting functional upgrading of TPFS during 1998-2016 are presented in Table 5-21. By using various data conversion techniques and OLS estimation, Table 5-21 shows that model (5) has a lower RMSE value than other models. The calculated R-square of model (5) is higher than that for other models.

Model (5), Table 5-21, shows the factors related to productive capacity (R&D and HD) are positively significant (at the 0.01 level) for the functional upgrading. This is because, when Thai private firms in the processed food industry desire to invest in overseas countries, such as a distributor in developed countries, R&D and skilled labourers are acknowledged as key factors. This is because those private firms need to comply with various product standards and requirements from buyers in developed countries (Bamber et al., 2014; Kowalski et al., 2015). Accordingly, the private firms need to increase their R&D and hire skilled labourers to run their business overseas. Both port performance and access to the internet (proxy for infrastructure and service) are insignificant variables. This is because functional upgrading occurring in TPFS is to move from a producer in a domestic country to a distributor in an overseas country, especially a developed country. Some large Thai companies in the

processed food industry perhaps could benefit from specific assistance from global buyers or business partners, rather than locally fundamental development (such as infrastructure and service). For example, Thai companies need to know how to acquire global retail brands and how to comply with business regulations in developed countries. This knowledge can be provided by collaboration between large Thai companies and MNEs from developed nations (Kohpaiboon, 2006; Thai Union Group Public Company Limited, 2016). For the business environment, political stability is negatively significant (at the 0.01 level) for functional upgrading. This means that if Thailand has political stability, functional upgrading is decreased. This is because political stability may lead to increased domestic investment rather than overseas investment. This result agrees with previous studies (Kayam, 2009; Klimek, 2015; OECD, 2011). In contrast, financial support is not significant for functional upgrading (see Table 5-21). This is because financial development may attract private firms to invest more domestically rather than overseas (Al-Sadig, 2013). For determinants related to trade policy, the results show that the trade openness index is insignificant. In the case of the Thai processed food industry, some large firms (such as TUF and Sea Value Group) have acquired global brands to transform from domestic producers to overseas distributors, especially in developed countries (Kuldilok, 2009). To achieve this, these firms need to be assisted by trading partners, particularly MNEs from developed countries, to comply with business regulations in those countries (Kohpaiboon, 2006). This finding agrees with Ponte and Ewert (2009) who state that participation in GVCs or shifting from an existing function to a new function within a GVC depends on leading firms that are usually MNEs. In particular, developing countries are usually allowed to upgrade themselves via the trajectories of product and process upgrading, rather than functional upgrading. Consequently, although Thailand relies heavily on international trade, the effort seems to be insignificant for the Thai processed food industry functional upgrading. The results also indicate that the presence of the analytical laboratory is positively significant (at the 0.05 level) for functional upgrading. In short, collaboration between the government and private sector is significant for functional upgrading.

Table 5-21 The Determinants Influencing Functional Upgrading

Dependent Variable: Functional upgrading

Regressors	Model							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnRD	2.90**	2.90**	0.62	0.23	1.93***	1.39*	1.84*	1.84*
	(1.22)	(1.22)	(0.65)	(0.77)	(0.65)	(0.80)	(1.02)	(1.02)
lnHD	10.98***	10.97***	11.07***	9.69**	10.24***	9.87***	8.55**	8.55**
	(2.80)	(2.80)	(3.83)	(3.96)	(2.46)	(2.75)	(3.26)	(3.26)
lnPORT	4.76	4.75	-1.22	-3.06	-0.99	-2.45	-1.78	-1.78
	(4.45)	(4.45)	(3.01)	(3.81)	(2.13)	(3.11)	(3.66)	(3.65)
lnINT	-3.42	-3.41	-0.09	0.87	-1.12	-0.26	-0.16	-0.16
	(2.28)	(2.28)	(1.45)	(1.83)	(1.04)	(1.54)	(1.92)	(1.92)
PS	-1.28***	-5.11***	0.70	0.06	-1.19***	-1.08***	-1.18***	-4.73***
	(0.32)	(1.27)	(1.41)	(1.34)	(0.34)	(0.33)	(0.35)	(1.39)
lnFINSUP	-3.75	-3.75	-0.27	1.06	-0.56	0.65	-1.32	-1.32
	(2.79)	(2.79)	(1.93)	(2.13)	(1.45)	(1.85)	(2.30)	(2.30)
lnTOPEN	-7.04	-7.02	1.02	2.78	-1.68	-0.02	-1.02	-1.02
	(4.52)	(4.52)	(2.53)	(3.49)	(2.21)	(3.38)	(3.52)	(3.52)
LAB	1.47*	1.47*	0.63**	0.26	0.62**	0.20	0.50	0.50
	(0.83)	(0.83)	(0.25)	(0.48)	(0.25)	(0.55)	(0.65)	(0.65)
Constant	-14.23	-9.47	-32.97***	-33.93***	-24.43***	-29.25***	-15.98	-8.88
	(9.59)	(7.08)	(8.91)	(8.99)	(7.68)	(7.35)	(9.67)	(6.94)
Obs.	64	64	61	61	61	61	64	64
F-Stat	79.72***	79.60***	61.5***	44.69***	81.27***	70.32***	43.69***	43.69***
R^2	0.8923	0.8923	0.8702	0.8656	0.9350	0.9303	0.8662	0.8662
RMSE	0.5395	0.5396	0.5372	0.5465	0.3801	0.3934	0.6199	0.6199

Note: 1. Models (1) - (8) are OLS regression results after comverting annual data to quarterly data. (1) is a constant-average method, (2) is a constant-sum method, (3) is a cubic-first method, (4) is a cubic-last method, (5) is a linear-first method, (6) is a linear-last method, (7) is a quadratic-average method, and (8) is a quadratic-sum method.

2. *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.

3. Numbers in parentheses are corrected standard errors.

Source: Author's calculations

5.3.4 The Determinants Influencing Social Upgrading

Table 5-22 shows the determinants affecting the Thai processed food industry's social upgrading between 1998 and 2016. According to the RMSE values in Table 5-22, model (2) has the lowest RMSE value. The R-square of model (2) is 57.01%.

Model (2), Table 5-22, shows several factors impact social upgrading. The determinants affecting productive capacity, R&D and human development, are positively significant at the 0.01 level. This is because an increase in R&D expenditure can lead to a shift in employment rate in the TPFS. In addition, human development can help labourers gain higher skills and, subsequently, higher wages (Bogliacino & Vivarelli, 2010; Cintio et al., 2017). The results show that port performance is positively significant (at the 0.01 level) in social upgrading. This suggests that port infrastructure development leads to social upgrading. This is because the port infrastructure development results in a shift in a relevant factor, improving employment rate (Jung, 2011; Musso et al., 2006; Rodrigue et al., 2009). However, access to the internet is a negatively significant variable at the 0.01 level. This is because the internet and relevant technology development can reduce the demand for labourers, especially those without skills. Private firms with internet systems/technology tend to hire only highly skilled labourers (Paul & Siegel,

2001; Terzi, 2011). Thailand's political stability (proxy for the business environment) is insignificant for social upgrading. Since global buyers frequently control the TPFS, the production of processed food products depends more on global demand. On the other hand, financial support is negatively significant (at the 0.01 level) for social upgrading. This is because financial development can attract private firms to invest more in sectors with the greatest profitability, especially in the manufacturing sector, rather than in the agri-food sector (Pagano & Pica, 2010). Additionally, previous research has shown that financial development increased the wages only of labourers with high skills (Jerzmanowski & Nabar, 2013). However, many parts of the Thai processed food industry still employ a number of low-skilled labourers, especially in the upstream links of processed food value chains (Kohpaiboon, 2006). For factors related to trade policy, the results show that the trade openness index is a negatively significant variable at the 0.01 level. This means that if countries rely heavily on international trade, social upgrading processes will be reduced. Majid (2004) states that a country is likely to seek higher export competitiveness when the trade openness of a country increases. This results in lower wages. Table 5-22 shows that the laboratory's presence is positive and significantly (at the 0.01 level) related to social upgrading. The laboratory's establishment can lead to increasing demand for labourers in the Thai processed food industry, especially for technicians. This finding supports previous studies that suggest that collaboration between the government and the private sector can lead to social upgrading, particularly in the area of employment (Bamber et al., 2014; Kowalski et al., 2015).

Table 5-22 The Determinants Influencing Social Upgrading

Dependent Variable: Social upgrading

Regressors	Model							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnRD	80.07***	20.0***	38.0***	39.37**	29.22***	29.85*	56.0***	14.00***
	(17.28)	(4.32)	(10.08)	(16.78)	(9.56)	(16.73)	(14.15)	(3.54)
lnHD	294.6***	73.58***	111.97*	112.26	153.7***	185.12***	232.6***	58.13***
	(56.83)	(14.19)	(58.9)	(68.44)	(53.61)	(64.00)	(58.55)	(14.63)
lnPORT	217.4***	54.27***	-34.65	-26.53	-3.32	32.25	85.28*	21.29*
	(57.95)	(14.48)	(51.79)	(83.24)	(38.83)	(67.69)	(49.65)	(12.41)
lnINT	-151.7***	-37.89***	-37.23	-42.19	-40.48**	-55.80	-85.46***	-21.35***
	(33.19)	(8.29)	(24.27)	(41.90)	(19.19)	(35.98)	(29.24)	(7.31)
PS	6.38	6.39	-33.14	-46.44**	8.62	11.76*	8.00	7.99
	(5.84)	(5.84)	(21.13)	(20.50)	(5.85)	(6.09)	(5.94)	(5.94)
lnFINSUP	-170.0***	-42.46***	-23.13	-15.74	-34.13	-38.30	-108.5***	-27.1***
	(39.15)	(9.78)	(31.13)	(46.26)	(26.05)	(41.61)	(30.57)	(7.64)
lnTOPEN	-	-58.17***	11.13	-6.10	-6.51	-43.21	-108.4**	-27.08**
	232.97***	(14.78)	(44.68)	(78.53)	(39.59)	(72.36)	(50.42)	(12.6)
	(59.15)							
LAB	51.81***	12.94***	17.48**	20.41	16.30***	20.50	31.72***	7.93***
	(12.29)	(3.07)	(7.26)	(14.93)	(5.82)	(12.68)	(11.41)	(2.85)
Constant	-154.96	-25.78	-105.95	-136.53	-267.66**	-380.6***	-204.2*	-26.28
	(110.57)	(19.54)	(105.91)	(108.19)	(112.40)	(130.68)	(112.59)	(18.94)
Obs.	64	64	61	61	61	61	64	64
F-Stat	7.42***	7.44***	7.58***	7.96***	7.40***	6.94***	3.61***	3.61***
R2	0.5703	0.5701	0.5990	0.5845	0.6074	0.5929	0.5064	0.5064
RMSE	9.5329	2.3836	8.7465	8.9033	7.6687	7.8095	10.457	2.6142

Note: 1. Models (1) - (8) are OLS regression results after comverting annual data to quarterly data. (1) is a constant-average method, (2) is a constant-sum method, (3) is a cubic-first method, (4) is a cubic-last method, (5) is a linear-first method, (6) is a linear-last method, (7) is a quadratic-average method, and (8) is a quadratic-sum method.

2. *, **, *** indicate statistically significant levels at 0.1, 0.05, and 0.01, respectively.

3. Numbers in parentheses are corrected standard errors.

Source: Author's calculations

5.4 A Discussion of the Determinants Influencing the Economic and Social Upgrading of Thai Processed Food Sector

The results in Tables 5-19 – 5-22 show that the impacts of the five-determinants on upgrading types are mixed. To show how the determinants differentially impact upgrading types, this section compares the empirical findings (see Table 5-23). Focusing first on the determinants related to productive capacity, R&D is positively significant for functional and social upgrading at the 0.01 level. This is because Thai firms in the processed food industry need to comply with various requirements of buyers, usually in developed countries, when they become a distributor in those countries. R&D and skilled labourers are key factors supporting this requirement. In addition, an increase in R&D can lead to a shift in employment in the processed food industry, such as increased demand for technicians. In contrast, R&D is an insignificant factor for product and process upgrading. Another variable in this group, human development, is positively significant for all upgrading types. This is because TPFS is characterised as a labour-intensive industry (The Office of Industrial Economics, 2015). Therefore, human development provides direct effects on all upgrading types.

For the determinants related to infrastructure and service, port infrastructure development is positively significant (at the 0.01 level) for process and social upgrading. This is because port infrastructure development tends to reduce transport costs because it enables easier movement. This supports high-quality export products (Bamber et al., 2014; OECD et al., 2014; Rodrigue et al., 2009). In addition, port infrastructure development results in an increase in relevant factors, such as an increased employment rate (Jung, 2011; Musso et al., 2006; Rodrigue et al., 2009). However, port infrastructure development is not significant for product and functional upgrading. Interestingly, the results show another factor related to infrastructure and service - access to the internet - is negatively significant (at the 0.1 and 0.01 levels, respectively) for process and social upgrading of TPFS. This implies that exporters gain some benefits (e.g., new information related to global trade) from internet development. They can seek new trading partners who have less strict product standards than traditional partners. Moreover, internet development can reduce the demand for labourers, particularly low-skilled workers (Paul & Siegel, 2001; Terzi, 2011).

The results show that political stability is positively significant (at the 0.01 level) for product and process upgrading (see Table 5-23). This result indicates that political stability leads to a shift in investors' and exporters' confidence in terms of investing in domestic markets, including developing production processes (Feng, 2011; World Bank, 2018). In contrast, political stability is negatively significant (at the 0.01 significance level) for functional upgrading since political stability can lead to increased in investment within one's home country, rather than overseas (Kayam, 2009; Klimek, 2015; OECD, 2011). Thus, a negative relationship between political stability and functional upgrading may emerge. The financial support variable is negatively significant for product and social upgrading at the 0.1 and 0.01 levels, respectively. Financial development can reduce liquidity constraints and facilitate exports. Exporters can seek new export opportunities. Exporters may diversify their exports to gain greater profitability (Manova, 2013; Pagano & Pica, 2010; Wamboye & Mookerjee, 2013). In addition, increasing employment and wages caused by financial development is sometimes found in hiring skilled labourers (Jerzmanowski & Nabar, 2013). However, several parts of Thailand's processed food industry still employ plenty of low-skilled labourers (Kohpaiboon, 2006). Accordingly, financial development can be negatively significant for product and social upgrading of TPFS.

For factors related to trade policy, the results show that increased trade openness is negatively significant (at the 0.01 level) only for process and social upgrading. This is because, when countries rely more on international trade, they may diversify their exports by creating new products and seeking new trading partners (Ali, 2017; Makhlouf et al., 2015). Moreover, increasing reliance on global trade can lead to lower wages to gain export competitiveness (Majid, 2004). As a result, there is a clear relationship between trade openness and these two upgrading types.

Our findings indicate that the laboratory's establishment has led to an increase in all upgrading types. In short, industry institutionalisation is positively significant for the economic and social upgrading of TPFS. Collaboration between government and private firms can enable sector upgrading.

In converting annual data to quarterly data to estimate the five determinants' impacts on product and social upgrading, the results show the constant-sum method is most suitable. On the other hand, the linear-first method was used to convert annual data to quarterly data before regressing the determinants' effects on process and functional upgrading (see Table 5-23).

Table 5-23 A Comparison of the Results of the Determinants Influencing Types of Upgrading

Regressors	Dependent Variable: Types of Upgrading			
	Product	Process	Functional	Social
lnRD	-0.53	0.05	1.93***	20.0***
lnHD	9.70*	2.38***	10.24***	73.58***
lnPORT	9.05	2.74***	-0.99	54.27***
lnINT	-3.63	-0.57*	-1.12	-37.89***
PS	9.64***	0.21***	-1.19***	6.39
lnFINSUP	-5.99*	-0.63	-0.56	-42.46***
lnTOPEN	-5.59	-2.28***	-1.68	-58.17***
LAB	2.98***	0.34***	0.62**	12.94***
Constant	-10.14	-5.47**	-24.43***	-25.78
Data Conversion Methods	Constant-sum	Linear-first	Linear-first	Constant-sum
F-Stat	10.88***	400.5***	81.27***	7.44***
R2	0.5430	0.9474	0.9350	0.5701
RMSE	0.7517	0.0926	0.3801	2.3836

Note: *, **, *** indicate statistically significant at 0.1, 0.05, and 0.01, respectively.
Source: Author's summary from Tables 5-19 to 5-22

5.5 Chapter Summary

This chapter presents the findings on the impact of economic and social upgrading on TPFEs between 1998 and 2016. The export performance of five product categories; total processed food, processed shrimp, processed chicken, canned tuna and canned pineapple, were examined. Trading partners were divided into three groups: all countries, developed countries and developing countries. The chapter also examined the five determinants' impacts on economic and social upgrading of Thailand's processed food industry. They are the determinants related to productive capacity, infrastructure and service, business environment, trade and investment policies, and industry institutionalisation. R&D and human development were used as proxies for productive capacity. Port performance and access to the internet were used to represent infrastructure and service development. The study used political stability and the availability of financial support as proxies for the business environment. The trade openness index was used as a proxy for trade and investment policies. For industry institutionalisation, the presence of the national laboratory (a dummy variable) was used as a proxy.

Briefly, product upgrading is positively significant for exports of all product categories. This is similar to previous studies' findings which showed that product upgrading is a key mechanism for maintaining

position (or moving up) GVCs. This is particularly true in the captive form of governance (Humphrey & Schmitz, 2002; Knorringa & Pegler, 2006; Schmitz, 2006). As discussed in Chapter 3, the governance form usually found in Thai processed food GVCs is the captive form.

The results show that process upgrading exhibits both negative and positive impacts on TPFEs during the study period. That is, to comply with global product standards, exporters/producers need to invest a significant amount of time and money. This effort can lead to an increased production costs and, subsequently, to reduced export competitiveness in global markets (Baylis et al., 2010; Jeffee & Henson, 2004). As a result, the process upgrading variable exhibits a negative impact on TPFEs. In contrast, learning by doing helps exporters comply with global prouduct standards. In addition, it helps producers/exporters achieve economies of scale and, subsequently, minimise production costs. As a result, the process upgrading lagged variable exhibits a positive impact on TPFEs.

For exports of specific processed food products, we find that process upgrading was particularly significant for sophisticated product exports (such as processed shrimp and processed chicken). However, process upgrading was insignificant for simple products such as canned pineapple. Process upgrading was less significant for processed food exports to developing countries than for those exports to developed countries.

Functional upgrading was important for TPFEs. This is the result of increased ownership of distribution channels, particularly in developed countries (Kohpaiboon, 2006; Kuldilok, 2009; Thai Union Group Public Company Limited, 2016). As a result, functional upgrading was significant in processed food exports to developed countries that are key export markets for Thai processed food products. However, functional upgrading was insignificant in TPFEs for developing countries. Functional upgrading was significant for exports of some specific processed food products, processed shrimp, processed chicken and canned tuna. In contrast, functional upgrading had an insignificant impact on processed food products in simple form such as canned pineapple.

Social upgrading was positively significant for TPFEs to all countries. However, for developed and developing countries separately, our results indicate that social upgrading was positively significant for TPFEs to developed countries. In contrast, social upgrading for TPFEs to developing countries was minor. This is because developed countries usually pay more attention to labour standards than developing countries, which usually focus on product price and quality (Dolan & Tewari, 2001; Lee & Gereffi, 2014; The Office of Industrial Economics, 2015; Singh, 2013). Thus, each upgrading type has a different impact on TPFEs. Producers and exporters must be aware of these differences and make the relevant selection.

For the five determinants influencing the upgrading of TPFS, our findings indicate that human development, political stability, and industry institutionalisation are positively significant for product upgrading. However, the availability of financial support is a negative significant variable for product upgrading. The study's results show that human development, port infrastructure development, political stability, and industry institutionalisation were positively significant for process upgrading. However, access to the internet and trade openness were negatively significant for process upgrading. For functional upgrading, we find that R&D, human development, and industry institutionalisation played key roles in functional upgrading. However, an increase in Thailand's political stability led to reduced functional upgrading. The study results show that R&D, human development, port infrastructure development, and industry institutionalisation were positively significant for social upgrading. However, access to the internet, the availability of finance and trade openness exhibit negative effects on social upgrading. Significantly, this study found that human development and industry institutionalisation supported all upgrading types. The results also suggest that each upgrading type requires different supporting policies. To create policies to support the upgrading of TPFS, policymakers need to be aware of their impact. In short, there is no 'one-size-fits-all' policy.

Chapter 6

Conclusions and Implications

This chapter summarises the study. The chapter is divided into four sections. Section 6.1 summarises the research findings. The implications of the research findings are provided in Section 6.2. Section 6.3 discusses the limitations of the study and recommendations for future research are presented in Section 6.4.

6.1 Summary of Research Findings

GVCs provide a framework for understanding new patterns of global trade. The main purpose of GVCs is to deliver products from upstream to downstream with the collaboration of all stakeholders within the chain for global optimisation (Gereffi, 1999; The Office of Industrial Economics, 2015). The GVC approach also connects developed and developing countries in world markets. Developed countries, which are usually global buyers, use various forms of governance (market relation, modular, relational, captive, and hierarchical) to control product standards along value chains (Gereffi et al., 2005). Developing countries, the major producers and exporters, need to upgrade their production processes to meet those standards. The key upgrading types are economic (product, process, functional, and inter-sectoral) and social upgrading (Bernhardt & Milberg, 2011b; Humphrey & Schmitz, 2002). The concept of GVCs is widespread in most productive sectors, especially the processed food sector, which is a rising star in agri-food trade.

Thailand has connected with the GVCs of processed food as a key producer and exporter to the world's markets. However, Thailand still faces many challenges related to global product standards and requirements. As discussed in Chapter 3, MNEs have control over Thai production processes using various forms of governance. If product characteristics are sophisticated and rely heavily on product standards, the governance forms used are usually captive and hierarchical, as found in Thai processed shrimp, processed chicken, and canned tuna value chains. In contrast, the governance market form is used to explain economic transactions in the Thai canned pineapple value chain, since this product is less governed by food safety standards than the other three products. In analysing the export competitiveness of TPFPs, we find that many key Thai export processed food products face the loss of the export competitiveness in world markets. These products are processed shrimp, canned tuna and canned pineapple. Conversely, during the study period, Thailand had more export competitiveness in processed chicken than other competitors in the world markets.

Based on the estimates from the augmented gravity model used in this study, our empirical findings suggested that economic and social upgrading impacts TPFEs differently. That is, product upgrading has positive impacts on exports of most product categories of TPFS. Interestingly, when we separate trading partners into two classes, developed and developing countries, we find that product upgrading still exhibits a positive impact on most processed food exports to developed countries. On the other hand, product upgrading has a positive impact on only some processed food exports to developing countries (canned tuna and canned pineapple). This implies that developed countries are more concerned about product quality than developing countries.

The process upgrading variable has a negative impact on TPFEs because of a shift in production costs for complying with global product standards. However, learning by doing helps producers and exporters comply with those standards and achieve economies of scale and, subsequently, to minimise production costs. As a result, the process upgrading lagged variable had a positive impact on TPFEs. Our findings also suggested that process upgrading is particularly important for sophisticated product exports to developed countries (e.g., processed shrimp and processed chicken). In contrast, process upgrading is less important for exports of processed food to developing countries than for these exports to developed countries.

We find that functional upgrading and its lagged variable are particularly significant in TPFEs to developed countries. In contrast, our results reveal that this upgrading type is insignificant for those exports to developing countries. These results agree with previous studies that there has been an increase in ownership of distribution channels of large Thai companies in the processed food export sector, particularly in developed markets (Kohpaiboon, 2006; Kuldilok, 2009).

The impact of social upgrading on TPFEs was significantly positive. In particular, social upgrading has more positive impact on TPFEs to developed markets than those exports to developing markets. These results confirm the findings of previous studies that buyers in developed countries pay more attention to labourer's rights and standards (Dolan & Tewari, 2001; Lee & Gereffi, 2014).

For the conventional variables used in the gravity model, the study's findings show that the GDP coefficients' signs for Thailand and its trading partners vary. For processed food exports to all countries, most findings showed that both the GDP of Thailand and its trading partners are insignificant for the exports. However, when we focus on only exports to developed countries, most results showed a positive relationship between GDP and TPFEs to those nations. In contrast, a negative relationship between the GDPs and processed food exports was found for exports to developing countries. The distance variable was mainly insignificant for TPFEs. This could be related to developments in food technology and logistics that can reduce the effect of geographic distance between Thailand and its trading partners.

Based on the coefficients' estimates of the GDP per capita of Thailand and its trading partners, our key findings suggest that TPFEs to developed countries are classified as labour intensive production and necessity products, as found for total processed food and processed shrimp exports. In contrast, TPFEs to developing countries were classified as capital intensive production and luxury goods (e.g., processed shrimp and processed chicken).

We find that the variable of trading partners' populations is insignificant for TPFEs to all countries. For TPFEs to developed countries, our main findings show a negative relationship between processed food exports and trading partners' populations (e.g., total processed food, processed shrimp and canned tuna). Conversely, a positive relationship between TPFEs and trading partners' population was found for the processed food exports to developing countries (total processed food, processed shrimp and processed chicken).

Of the other variables, a common border exhibits both negative significance and insignificance for TPFEs. This is because the main destinations of TPFEs are developed countries, not neighbouring nations. Our main findings show that trade agreements do not have a positive impact on TPFEs to developed countries. However, there were positive relationships between trade agreements and TPFEs to developing countries, as found for processed food and processed chicken exports. The 2008 global financial crisis variable was hypothesised to have a negative impact on TPFEs. However, our results suggest that this variable had either a positive or no impact on TPFEs during the study period. The real exchange rate was significant in TPFEs with various coefficients' signs. For instance, depreciation of the Thai baht boosted processed chicken and canned pineapple exports to developed countries. In contrast, there was a negative relationship between the real exchange rate and TPFEs for processed food exports to developing countries. This is because Thailand frequently exports those products to ASEAN countries, most of which are categorised as developing nations. Moreover, intra-trade in ASEAN usually uses both the U.S. Dollar and Thai baht as trade currencies. As a result, a shift in intra-trade in ASEAN can lead to appreciation of the Thai baht.

This study identifies the key determinants influencing economic and social upgrading of TPFS. The results show that the key determinants had different impacts on each upgrading type. For the determinants related to productive capacity, the study's results suggest that human development is positively significant for all upgrading types. In contrast, R&D was positively significant for only functional and social upgrading. Our findings also suggest that the importance of infrastructure and service to the upgrading types varies. For instance, port development was positively significant for process and social upgrading types. On the other hand, there was no relationship between port development and product and functional upgrading. The variable access to internet was negatively significant for process and social upgrading types and insignificant for product and functional

upgrading types. For the business environment, the political stability and financial support variables reveal different impacts on each upgrading type. Political stability had a positive impact on product and process upgrading. In contrast, it had a negative impact on functional upgrading. The financial support variable was negatively significant for product and social upgrading. This variable had no significance for the process and functional upgrading types. The trade openness variable had a negative impact on process and social upgrading. Conversely, trade openness variable had no impact on product and functional upgrading. The presence of a national laboratory, which was used as a proxy for industry institutionalisation, had a positive impact on all upgrading types of TPFS during the study period. To create policies to support upgrading of TPFS, policymakers need to be aware of their specific impact; there is no 'one-size-fits-all' policy.

6.2 Implications of the Findings

6.2.1 Academic Implications

The findings of this study have some academic implications, especially adding to the literature. Based on the literature, many scholars acknowledge that the key advantage of economic and social upgrading is to maintain and improve a country's/supplier's position in the GVCs to gain more benefits from trade networks (Elms & Low, 2013; Ponte & Ewert, 2009). However, there is no empirical research that examines the impact of economic and social upgrading types on trade, particularly exports. In addition, the augmented gravity model has been commonly used to investigate many variables (e.g., macroeconomic variables and some specific trade issues) on trade flows. However, the economic and social upgrading variables have rarely been used in the gravity model. This study empirically estimated the economic and social upgrading variables and included them in an augmented gravity model, like other common variables. The empirical models and their estimates in this study suggest that the economic and social upgrading variables are significant for TPFEs. This provides concrete evidence that supports the importance of those upgrading types to trade, especially traded processed food.

Previous authors argue that developed countries pay more attention to multiple standards, such as food safety and labour standards, than developing countries. When producers and exporters desire to export their products to developed markets, they need to comply with those standards (Anders & Caswell, 2009; Lee & Gereffi, 2014). This implies that economic and social upgrading become significant factors for a country's exports to developed markets. According to our empirical findings, economic and social upgrading were more significant in TPFEs to developed markets than TPFEs to developing markets. Hence, our results provide evidence to support the argument in previous studies.

According to the gravity model, the signs of the GDP (for both exporting and importing countries) coefficients are expected to be significantly positive. However, this study's finding was that the signs

are mixed; they are positively and negatively significant, and insignificant. The negative sign of the GDP coefficient can explained: if a country's economy is large (small), that country tends to rely less (more) on trade. The GDP may be insignificant to trade for a specific product or a particular market. This is because exporting or importing values are less significant in terms of GDP (Gebrehiwet et al., 2007; Kareem, 2013; Mulapruk & Coxhead, 2005). These findings suggest that future studies should take into account the sign of the GDP coefficient in the gravity model. In addition, our results reveal that that GDP is not always significant in the gravity model.

Previous empirical research suggested that some geographic factors in the gravity model, such as distance and common border, are significant for exports. That is, the distance variable is expected to be a trade impediment. In contrast, the common border is expected to increase trade between the two countries that share a common border because of the lower transport costs. Our results find that these two variables are insignificant for TPFEs. This implies that technology development and logistics influence the processed food production and export sector. Our findings support the argument of Athukorala et al. (2002) who note that technology development and logistics helps exporters export their products across regions and to increase their trade network regardless of geographic factors, such as distance and a common border.

The study's findings also show different signs for other coefficient variables used in the gravity model when focusing on the models for processed food exports to developed markets versus those exports to developing markets. For instance, the coefficients' signs of Thailand and trading partners' GDP per capita were negative in relation to processed food exports to developed countries, but positive for exports to developing countries. This means that when TPFEs to developed (developing) markets, they are classified as a labour (capital) intensive industry and with necessary (luxury) products. These findings indicate the different perspectives of global buyers (developed versus developing markets) may have on TPFEs.

One of the most important reasons for creating trade agreements is to reduce tariff barriers and encourage countries to expand their exports and imports. Previous empirical studies suggested that trade agreements have both significant and insignificant impacts on exports (Bergstrand, 1989; Sohn, 2005; Tran et al., 2012). However, our findings suggest that trade agreements are often insignificant in TPFEs. This can indicate that trade agreements signed by Thailand and its trading partners have not been very effective in the expansion of TPFEs. Our findings also clearly cast light on the complex issues around the trade in processed food, especially the stringent product and food safety standards required by trading partners. This means that a reduction in tariff barriers does not guarantee export expansion. This is because the key barrier to the Thailand's processed food appears to be product and food safety standards.

To regress the augmented gravity model used in this study, we used various estimation methods, PPML, NBPML, FEM and REM. Our findings confirm that the PPML provides robust results, superior to the other methods. The results also support the research by Santos Silva and Tenreyro (2006) and (2011). They suggest that PPML can provide better outcomes with the gravity model, even though there is the overdispersion problem and excessive zero trade values in the model. Although some studies present alternative estimation methods such as NBPML (Burger et al., 2009) to deal with the gravity model, our empirical findings indicate that the outcomes from NBPML are not superior to the outcomes from PPML.

Finally, this study identified the key determinants influencing the economic and social upgrading of the TPFS. Our core findings suggest that human development and a positive collaboration between government and the private sector are positively significant for all upgrading types. This implies that these determinants have direct effects on the upgrading of the TPFS, which needs a large number of skilled labourers. However, this study also reveals some results that differ from previous studies. For example, Bamber et al. (2014) and Kowalski et al. (2015) argue that access to financial support is one common factor that has a positive impact on the agri-food sector's development in global trade. However, our key findings suggest that an increase in financial support does not have a positive effect on economic and social upgrading of the TPFS. This gives a different view of the impact of financial support on the processed food sector's development for a different country.

6.2.2 Policy Implications

The study's findings study have several policy implications for Thailand's policymakers, especially in government agencies. With respect to the importance of economic and social upgrading of TPFEs, the Thai government needs a good understanding of the upgrading concept and how to encourage producers and exporters to meet upgrading standards. In particular, product upgrading should be raised as a key, fundamental element of the TPFS. This is because most findings in Chapter 5 suggest that product upgrading has a positive impact on TPFEs to both developed and developing markets. In addition, previous studies suggested that product upgrading is the basis of survival within GVCs (Humphrey & Schmitz, 2002). As a result, the government should design programmes to support local producers and exporters achieve product upgrading. For example, the government should provide updated information related to product quality proposed by global buyers to local producers and exporters. The government can gather updated information through collaboration with universities and large Thai companies that have long experience in product upgrading. This will help local producers and exporters keep producing high quality products. For newcomers to TPFS, these activities will help them to learn how to produce high quality products and maintain the high standards.

The findings of this study suggested that the process upgrading (lagged) variable has a negative (positive) impact on the TPFEs. This implies that producers and exporters have to invest in knowledge technology in order to comply with various product standards particularly required by developed markets. This can lead to a rise in production costs and subsequently the loss of export competitiveness. Therefore, the government should design some assistance related to process upgrading for local producers and exports. For instance, the government could collaborate with local financial institutions to provide some special loans with low interest rates and fees to local producers and exporters for upgrading their production processes. Again, the government could provide some relief related to import taxes of machinery for upgrading the production processes of local producers. These activities may assist local producers in reducing their production costs. In addition, the government could provide some specialists and updated information related to global product standards to local producers and exporters. The knowledge and experience of those specialists could assist producers and exporters to comply with the regulations concerning product standards in developed markets.

The study's findings also suggest a positive relationship between functional upgrading and growth in TPFEs. This implies that an increase in distribution channels in global markets can stimulate TPFEs, as evidenced by Thai processed shrimp and canned tuna exports to developed markets. The government agencies could provide accurate, updated information related to company establishment for product distribution in overseas countries to local producers and exporters. Examples of updated information are procedures and business laws related to company establishment in overseas countries. However, company establishment for product distribution in overseas countries needs a large investment. Local small and medium companies in TPFS may not be able to do this. The government can encourage small and medium companies to form joint ventures to reduce investment costs. Moreover, the government should provide some funding to support joint ventures' company establishment in overseas countries.

Labour standards have become a key concern in modern trade. In particular, our findings suggest that social upgrading has a positive impact on TPFEs to developed nations. Hence, the government must pay attention to development of labour standards and employees' rights. The government must take steps to eliminate problems related to labour standards, such as human trafficking and child labour, that are still found in some industries in Thailand, especially in the fishery sector (The Office of Industrial Economics, 2015). The effective enactment and policing of laws to prevent such behaviour by companies should be implemented. Additionally, the government should guide local processed food companies in improving labour standards in the companies. The government can cooperate with all stakeholders in the processed food industry, such as workers, labour unions, company owners, exporters and technicians from overseas countries, to improve the labour standards of the Thai processed food industry.

We find that trade agreements are frequently ineffective in terms of expanding TPFEs. Although Thailand gains advantages from trade agreements, such as reduced import taxes from trading partners, this does not appear to guarantee the growth of TPFEs. This implies that traded processed food relies heavily on other issues, especially product standards, rather than the privileges related to import tariffs. Hence, the government has to pay more attention to non-tariff regulations when they negotiate trade agreements with new trading partners. For instance, the government should increasingly focus on the RoO and food safety standards required by trading partners. This is because each trading partner may have its own product standards and specific requirements. Sometimes, some of them are more onerous than global standards, making them difficult to comply with (Jongwattanakul, 2012; Kohpaiboon, 2006). As a result, those standards and requirements may become new trade barriers.

Based on the findings of the determinants influencing the upgrading of the TPFS, human development appears to be important to all upgrading types. In particular, this sector is classified as a labour intensive industry. This suggests that the government should pay more attention to HRD and management. For instance, the government should develop more technical and vocational education. This will increase the number of specialists and technicians to support the growth of the sector. In addition, the government could bring in specialists from overseas nations, especially from key trading partners, to introduce new knowledge and technology to local companies in TPFS. The government could provide some incentives, such as tax exemptions, to encourage producers to develop their human resources. In addition, our findings suggest that collaboration between government and the private sector has a positive impact on all upgrading types. Based on this, the government and private sector should collaborate to design policies to support the development of TPFS. For example, the government and the private sector should increase the number of national laboratories for product standard investigation. This would provide a rigorous basis for examining and developing product quality for local producers and exporters. This also reduces the costs of investigation compared with using foreign laboratories.

This study suggests that other determinants, for instance infrastructure and services, and political stability (see Chapter 5), have different impacts on the upgrading types. If the government aims to focus on some specific determinants, it should be aware of those determinants' impacts. For example, port development had a positive impact on process and social upgrading, but had no impact on product and functional upgrading. An increase in political stability in Thailand had a positive impact on only product and process upgrading. It had a negative impact on functional upgrading. This implies that there is no 'one-size-fits-all' policy.

6.2.3 Managerial Implications

The study's findings have some managerial implications for Thai producers and exporters who are in TPFS. Our results suggested that product upgrading has a positive impact on most TPFEs. This implies that product upgrading is the basis of survival in GVCs that producers and exporters need to achieve. Thus, producers and exporters should primarily focus on product upgrading. Strategies to support product upgrading should be developed. For instance, producers and exporters could gather and update information related to product quality and the standards required by global buyers. At this stage, producers and exporters should cooperate with other local firms, government agencies and universities to update information. In addition, producers and exporters must pay more attention to producing products with higher quality rather than producing products with lower cost regardless of product quality. In short, awareness of product quality should be the priority for processed food production in Thailand.

Our results suggest that investment in process upgrading has both positive and negative impacts on TPFEs. That is, increased investment leads to a shift in production costs and, subsequently, to increased product price. This can lead to the loss of export competitiveness in world markets. In contrast, learning by doing helps producers and exporters gain experience about how to comply with global product standards. Therefore, producers and exporters need to be careful in their investment in process upgrading. In particular, they should focus on process upgrading when they export processed food products (especially products that are sophisticated and highly related to food safety issues) to developed countries. This is because our findings suggest that process upgrading has a significant impact only on processed food exports to developed markets. In particular, process upgrading has a significant impact on processed food products whose characteristics were complex and heavily reliant on food safety standards, such as processed shrimp. However, process upgrading had no impact on processed food exports to developing markets. As a result, when producers and exporters plan to invest in upgrading their production processes, they should be aware of exporting product characteristics and their trading partners' requirements.

The study's findings also confirm the importance of functional upgrading for TPFEs. This means that firms should shift their position from simply producers to become more vertically integrated. For example, exporters could invest in an increase in product distribution channels in overseas markets to expand their processed food exports. They may form joint ventures with foreign firms to create companies for product distribution. In addition, exporters should cooperate with others, such as government agencies and other firms, to achieve functional upgrading. For example, exporters could request assistance from government agencies, such as business information, guidance for company

establishment in overseas markets, and in seeking foreign business partners. This could help Thai exporters to estimate the cost-benefits of investment in such ventures.

This study finds that social upgrading has a positive impact on TPFEs, especially to developed countries. As previously discussed, Thai producers and exporters must develop labour standards used in their company to meet with requirements of global buyers and should cooperate with government agencies, such as the Ministry of Labour, to improve labour standards. Private firms in TPFS should pay more attention to wages and employment. Sharing correct, transparent information related to labourers' rights and relevant issues between firms and labour unions could help to improve labour standards.

Since most findings suggest that the distance variable is insignificant for TPFEs, it may imply that developments in food technology and transport mitigate trade barriers caused by geographic distance. Thai producers and exporters can export processed food products across regions based on this feature. Therefore, they should use various kinds of food technology to improve their processed food products for export. For example, producers and exporters could develop dehydration, drying and air-frying to keep the fresh, original taste and texture of the processed food products. Again, they could cooperate with government agencies and their trading partners to improve logistic systems for trading processed food. For example, they could cooperate in developing cold or cool chains that are temperature-controlled supply chains. The development of cold or cool chains can extend the shelf life of some processed food products.

Creating new trading partners for processed food exports is important for Thai exporters. In particular, the study's findings suggest the positive relationship between the population size of developing countries and TPFEs. This implies that an increase in the population of those countries creates greater opportunities for TPFEs. In addition, our findings suggest that the 2008 global financial crisis had no impact on TPFEs. As discussed in Chapter 3, the importance of the export diversification of Thai processed food products increased during the crisis to maintain the export competitiveness of those products. Thailand particularly diversified those exports to developing markets (i.e., neighbouring countries) when they face a slump in traditional export markets (such as the U.S.). As a result, producers and exporters in the TPFS should create new strategic plans for their future export diversification to alternative markets, particularly developing markets. This will help expand and maintain their export volumes, particularly when they face uncertainty in their traditional exporting markets. However, they have to be aware of the trade regulations of new partners that may differ from traditional trading partners.

As discussed earlier, producers and exporters should primarily focus on HRD and effective collaboration with the government to support economic and social upgrading. They may hire some

specialists to teach the new information to their staff. In addition, they may create projects to support their staff to learn new production techniques, especially from developed countries, and visit processed food production plants located in those countries. In addition, as previously discussed, producers, exporters and the government may invest in national laboratories to investigate and research product standards and cooperate in developing vocational education in Thailand to produce employees with high skills for TPFS.

6.3 Limitations of the Study

There are several limitations related to the data and methodology used in the study. They are:

- The measures of economic and social upgrading variables were limited. Although there has been previous research on the importance of economic and social upgrading to trade, the numeric measures of a variety of measurements and definite methods of upgrading types have been scarce. In particular, this study was not able to measure inter-sectoral upgrading in numeric terms since the term inter-sectoral upgrading explained only upgrading from a general perspective. As a result, it is difficult to quantify inter-sectoral upgrading or use proxy variables.
- In addition, this study quantifies product, process, functional and social upgrading in relation to the aggregated values of the Thai processed food industry using the available data. This means that we were not able to estimate product, process, functional and social upgrading in numeric terms for each product category. Therefore, when focusing on the impacts of the upgrading types on the export of each specific product (such as processed shrimp and chicken), the findings need to be interpreted with caution. This means that the findings may reveal over- or under-estimated impacts on those exports.
- The sample size used in this study was limited by the data availability of some variables. For example, the number of import refusals used to calculate process upgrading has been completely reported by two main sources: the FDA and the RASFF. The earliest, complete data from these two sources are from 2002. In addition, this study was not able to access the number of import refusals reported by other key trading partners of Thailand such as Japan. More complete data would improve the study's findings.
- This study focused on only four specific product categories: processed shrimp, processed chicken, canned tuna, and canned pineapple. These are key export products of the TPFS. However, the impacts of economic and social upgrading on the export of other exported processed food products may be different.
- Because of the miscellaneous export value problem, a cut-off point was used to eliminate insignificant export values to avoid misleading interpretations. However, previous research

suggests that there is no definite method for the selection of the cut-off point. The cut-off point used in this study was 0.5 per cent of the average export value of processed food product during 1998-2016. Although most export values of processed food products and trading partners were included (see details in Appendix D), a changed cut-off point or method may provide different results.

- With respect to determinants influencing economic and social upgrading of TPFS, this study uses some variables as proxies for the five-key determinants. This study faced the problem of the short period data used in the analysis. In particular, Thailand lacks a long period of macroeconomic data, such as data related to port infrastructure development. Moreover, the macroeconomic data are mainly reported as annual values. To overcome this constraint, this study applied the frequency conversion technique to convert annual data into quarterly data to expand the dataset. Hence, the study results in the context of the determinants that influence the upgrading types may change if the variables related to those determinants change.

6.4 Recommendations for Future Research

This section suggests directions for future research. The suggestions are:

- Because of the limitation of economic and social upgrading measures used in this study, future studies should use alternative methods to estimate economic and social upgrading in numeric terms if there is updated knowledge related to the measures. Future studies can compare the quantification of economic and social upgrading by different methods. This will be useful in checking the robustness of the quantification.
- This study estimates economic and social upgrading only in relation to the aggregated values of Thai processed food industry because of data availability. Future research should attempt to estimate economic and social upgrading of each specific product if relevant data are available. Future research can use the upgrading of each specific product to examine its effects on the exports of that product. The result of the impact of economic and social upgrading on the export of each specific product may be more precise.
- The scope of this study can be extended to analyse other export products, particularly in the agri-food sector. For example, future research could explore the governance form used in value chains of other products. In addition, future research could investigate if there is any impact of economic and social upgrading on the export of other product categories in the agri-food sector (such as dried fruits and other seafood products). Importantly, this will be helpful to policymakers to create more specific policies to support the export growth of those products.

- With regard to the trading partners, this study separated trading partners into three cases: all countries, developed countries, and developing countries. Future studies can extend the scope of this study to create new characteristics of trading partners. For instance, future research may separate groups of trading partners based on regions, such as Africa, Asia, and Latin America. Moreover, future research may focus on trade across regions or within regions. In addition, future studies might separate groups of trading partners based on the income levels of countries, e.g., high-, middle- and low-income countries. The new results would provide a better understanding about the impact of economic and social upgrading on exports to each trading partner group and trade within regions or across regions.
- Future studies could compare the impact of economic and social upgrading on TPFEs and the upgrading impacts on exports of other countries in the world markets. This is because each exporter faces different impacts of economic and social upgrading on his/her processed food exports. A comparative study between Thailand and other key exporters could indicate a different level of development in the processed food GVCs of each exporter. This would provide more robust results that support the importance of economic and social upgrading of processed food exports in global trade.
- To enlarge dataset and provide more contributions in area of the GVC analysis, future studies could focus on a group of countries rather than a specific country. In particular, future studies could examine the impact of economic and social upgrading on processed food exports of a group of developing countries that are key producers and exporters of the product in global trade. This could increase the generalisation of the results of the economic and social upgrading impacts on traded processed food of developing countries.
- Future studies could employ new cut-off points to deal with the miscellaneous export value problem. Different criteria for the cut-off points may provide different results of the impact of economic and social upgrading on exports. Moreover, the results could be used to compare and improve the robustness of the research findings about upgrading impacts on exports.
- Regarding the model of the determinants influencing economic and social upgrading, future research could consider the impacts of other determinants on the upgrading. For example, future studies could include new factors related to financial support and trade and investment policy in the model. This is because the finding of this study suggests that variables related to financial support and trade and investment policy are insignificant for economic and social upgrading. Changes in the determinants used in the model may provide different results. However, data availability of new factors should be addressed before including them in the model.
- Finally, future research could focus on more in-depth information in relation to the importance of GVCs of processed food. For example, future researchers could interview staff in processed

food companies in Thailand about whether GVCs are important to those companies. Staff of processed food companies may be able to share their valuable experience about how to comply with production standards, especially in practical terms, to researchers. They are also able to share experience in terms of the benefit they gain from GVCs of processed food, e.g., how participation in GVCs of processed food helps improve their living standards (higher wages and greater knowledge). In addition, future research could examine the impact of economic and social upgrading on exports, including determinants influencing upgrading at the firm-level. The results will enhance our understanding of the GVCs analysis of TPFS.

Appendix A

A List of Processed Food Products

Table A-1 HS Code of Processed Food Products

List of Products	HS Code (2002)
Processed Foods	
Meat Products	02+1601+1602+1603
Dairy Products	04 – 0407 – 0408 – 0409 – 0410
Fish Products	03+1604+1605
Flour and Cereals	1101+1102+1103+1104+1107+190410+190420+ 190430+1905
Vegetable	0712+1105+1106+2001+2002+2003+2005
Fruits, Fresh or Dried	0811+0812+0814+190300+2006+2007+2008+2009
Eggs and Egg Products	0407+0408
Sugar Preparations and Honey	170191+170199+1702+1704+0409
Coffee Extracts, Instant Tea, Cocoa-based Products	0902+0903+1803+1804+1805+2101
Processed Vegetable Oils	1509+1510+151211+151219+151521+151529+ 151530+1522
Other Edible Products and Preparations	0410+1901+1902+2102+2103+2104+2105+2106+ 2209
Key Exporting Products	
Processed Shrimp	030613 + 160520
Processed Chicken	160232
Canned tuna	160414
Canned Pineapple	200820

Note: 1. The list of processed products and key products are adapted from Kohpaiboon (2006), Jongwanich (2009), and the Kasikorn Research Centre (2016a)

2. The HS codes of the list of processed food products are converted from Standard International Trade Classification (SITC) Rev.2 by using the correspondence table between HS2002 and SITC Rev. 2 proposed by the United Nations Statistics Division.

Source: Calculated by the author

Appendix B

A List of Countries by Status

Table B-1 A List of Countries by Status

Lists of Developed Counties
Andorra, Australia, Austria, Belgium, Bulgaria, Canada, Croatia, Czech Republic, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Netherlands, New Zealand, Norway, Poland, Portugal, Romania, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, United Kingdom , United States of America
Lists of Developing Counties
Afghanistan, Albania, Algeria, Angola, Antigua and Barbuda, Argentina, Armenia, Azerbaijan, Bahamas, Bahrain, Bangladesh, Barbados, Belarus, Belize, Benin, Bhutan, Bolivia, Bosnia and Herzegovina, Botswana, Brazil, Brunei Darussalam, Burkina Faso, Burundi, Cabo Verde, Cambodia, Cameroon, Central African Republic, Chad, Chile, China, Colombia, Comoros, Costa Rica, Côte d'Ivoire, Cuba, Cyprus, Democratic Republic of the Congo, Djibouti, Dominica, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Eritrea, Ethiopia, Fiji, Gabon, Gambia, Georgia, Ghana, Grenada, Guatemala, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Hong Kong, India, Indonesia, Iran, Iraq, Israel, Jamaica, Jordan, Kazakhstan, Kenya, Kiribati, Kuwait, Kyrgyzstan, Laos, Lebanon, Lesotho, Liberia, Libya, Macau, Macedonia, Madagascar, Malawi, Malaysia, Maldives, Mali, Malta, Marshall Islands, Mauritania, Mauritius, Mexico, Micronesia, Moldova, Monaco, Mongolia, Montenegro, Morocco, Mozambique, Myanmar, Namibia, Nauru, Nepal, Nicaragua, Niger, Nigeria, North Korea, Oman, Pakistan, Palau, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Qatar, Republic of the Congo, Russia, Rwanda, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and the Grenadines, Samoa, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, Seychelles, Sierra Leone, Singapore, Solomon Islands, Somalia, South Africa, South Korea, South Sudan, Sri Lanka, Sudan, Suriname, Swaziland, Syria, Tajikistan, Tanzania, Timor-Leste, Togo, Tonga, Trinidad and Tobago, Tunisia, Turkey, Turkmenistan, Tuvalu, Uganda, Ukraine, United Arab Emirates, Uruguay, Uzbekistan, Vanuatu, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe

Note: For 'total countries', there are 193 fully recognised developed and developing countries. However, this thesis adds two special administrative regions, Macau and Hong Kong, into the list of developing countries since they have been important to Thai exports over the past three decades.

Source: The United Nations (2016) and The United Nations (2017)

Appendix C

A Literature Review of International Trade Models

Table C-1 A Literature Review of International Trade Models

	Tinbergen (1962)	Linnemann (1966)	Bergstrand (1985)	Bergstrand (1989)	Oguledo and Macphee (1994)	Matyas (1997)	Kim (1998)	Marchant et al. (1999)	Otsuki et al. (2001)	Glick and Rose (2002)	Baltagi et al. (2003)
Model											
Gravity Model	✓	✓	✓	✓	✓	✓			✓	✓	✓
Others							✓	✓			
Dependent Variable											
Imports		✓			✓						
Exports	✓	✓	✓			✓	✓	✓			✓
Bilateral Trade Flows				✓						✓	
Other Variables											
Independent Variable											
Demand and Supply Variables											
Partial Analysis											
GDP	+,+	+,+	+,+	+,+	+,+	+,+	x,+				
GDP/GNP per capita				±,±					+,+		
Population		-,-			-, x	±,+	x,±				
Total Analysis											
Product of GDP/GNP										+	+
Product of GDP/GNP per Capita										+	
Export Specialisation											
Share of Intra-industry Trade											
Resource Endowment											
Relative Country Size											+
Difference in Relative Factor Endowment											±
Other Macroeconomic Variables											
Price Instability											
Economic Crisis											
Political and Social Issues					-						
FDI								+			
Trade Facilitation											

Table C-1 (Continued)

	Tinbergen (1962)	Linnemann (1966)	Bergstrand (1985)	Bergstrand (1989)	Oguledo and Macphee (1994)	Matyas (1997)	Kim (1998)	Marchant et al. (1999)	Otsuki et al. (2001)	Glick and Rose (2002)	Baltagi et al. (2003)
Geographic Variables											
Distance	-	-	-	-	-				-	-	
Language										+	
Adjacency			+	+						+	
Common Region					-						
Landlocked										-	
Transport Costs											-
Important Policies and Institutional Variables											
Monetary Regime											
Nominal/Real Exchange Rates			+	+	-	±					
Exchange Rate Volatility											
Common Currency										+	
Foreign Currency Reserves						+					
Trade Policies											
Trade Openness/Trade Policy Regime											
Trade Agreements (e.g., FTAs)	+n	+	+	+							
Food Safety & Standards (e.g., SPS & Import Refusals)									-		
Other Non-tariff Barriers											
Tariff Barriers					-		-				
Privilege Related Trade (e.g., GSP)					±						
Economic and Social Upgrading Variables											
Product Upgrading			-		±			-			
Process Upgrading											
Functional Upgrading							+				
Inter-sectoral Upgrading											
Social Upgrading											

Table C-1 (Continued)

	Tinbergen (1962)	Linnemann (1966)	Bergstrand (1985)	Bergstrand (1989)	Oguledo and Macphee (1994)	Matyas (1997)	Kim (1998)	Marchant et al. (1999)	Otsuki et al. (2001)	Glick and Rose (2002)	Baltagi et al. (2003)
Country Analysis											
Multilateral Countries	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
A Specific Country					✓		✓				
Product Analysis											
Aggregated Products	✓	✓	✓		✓	✓	✓			✓	✓
Disaggregated Products				✓			✓	✓	✓		
Econometric Estimate Method											
OLS	✓	✓	✓	✓	✓		✓				
GLS/ FGLS											
Pooled OLS										✓	
Simultaneous Equations								✓			
Fixed Effect Approach						✓			✓	✓	✓
Dynamic Panel Data											
PPML/GPML/NBPML											
Zero-Inflated Models											
Time series Methods (e.g., VAR, Co-integration)											
Others (e.g., discreat models)											

Table C-1 (Continued)

	Egger and Pfaffermay (2003)	Schumacher (2003)	Wilson et al. (2003)	Martinez-Zarzoso & Nowak-Lehmann (2003)	Dehejia & Samy (2004)	Giorgio (2004)	Disdier et al. (2007)	Mulapruk and Coxhead (2005)	Sohn (2005)	Tang (2005)	Wilson et al. (2005)
Model											
Gravity Model	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Others					✓						
Dependent Variables											
Imports						✓	✓				
Exports	✓		✓	✓				✓		✓	
Bilateral Trade Flows		✓							✓		
Other Variables					✓						
Independent Variables											
Demand and Supply Variables											
Partial Analysis											
GDP/GNP	+,+	+,+	+,+	+,+		±,±	+,+	+,+			+,+
GDP/GNP per Capita		±,±	-,-								-,-
Population	-,±			-,±		-,-		-,-			
Total Analysis											
Product of GDP/GNP									+	+	
Product of GDP/GNP per Capita										+	
Export Specialisation											
Share of Intra-industry Trade											
Resource Endowment											
Relative Country Size											
Difference in Relative Factor Endowment				+							
Other Macroeconomic Variables											
Price Instability											
Economic Crisis											
Political & Social Issues											
FDI											+
Trade Facilitation			+	±							+

Table C-1 (Continued)

	Egger & Pfaffermay (2003)	Schumacher (2003)	Wilson et al. (2003)	Martinez-Zarzoso & Nowak-Lehmann (2003)	Dehejia and Samy (2004)	Giorgio (2004)	Disdier et al. (2007)	Mulapruk and Coxhead (2005)	Sohn (2005)	Tang (2005)	Wilson et al. (2005)
Geographic Variables											
Distance	-	-	-	-		-	-	-	-	-	-
Language	±	+	+	+			+				
Common Border	+	±	+				+				+
Common Region			+	+		+				+	±
Landlocked											
Transport Cost											
Important Policies & institutional Variables											
Monetary Regime											
Nominal/Real Exchange Rates	+			+		±					
Exchange Rate Volatility										-	
Common Currency											
Foreign Currency Reserves											
Trade Policies											
Trade Openness/Trade Policy Regime		+									
Trade Agreements (e.g., FTAs)									+		
Food Safety & Standards (e.g., SPS & Import Refusals)							-				
Other Non-tariff Barriers											
Tariff Barriers			-				-				
Privilege Related Trade (e.g., GSP)											
Economic and Social Upgrading Variables											
Product Upgrading											
Process Upgrading											
Functional Upgrading											
Inter-sectoral Upgrading											
Social Upgrading					+						

Table C-1 (Continued)

	Egger & Pfaffermay (2003)	Schumacher (2003)	Wilson et al. (2003)	Martinez-Zarzoso & Nowak-Lehmann (2003)	Dehejia and Samy (2004)	Giorgio (2004)	Disdier et al. (2007)	Mulapruk and Coxhead (2005)	Sohn (2005)	Tang (2005)	Wilson et al. (2005)
Country Analysis											
Multilateral Countries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
A Specific Country											
Product Analysis											
Aggregated Products	✓	✓		✓					✓	✓	
Disaggregated Products		✓	✓		✓	✓	✓	✓			✓
Econometric Estimate Method											
OLS		✓			✓		✓				
GLS/FGLS											✓
Pooled OLS	✓			✓		✓			✓	✓	✓
Simultaneous Equations										✓	
Fixed Effect Approach	✓		✓	✓		✓		✓			✓
Dynamic Panel Data				✓							
PPML/GPML/NBPML											
Zero-Inflated Models											
Time Series Methods (e.g., VAR, Co-integration)											
Others (e.g., discreat models)											

Table C-1 (Continued)

	Carrère (2006)	Santos Silva and Tenreyro (2006)	Gebrehiwet et al. (2007)	Papazoglou (2007)	Nordås (2008)	Paas et al. (2008)	Anders and Caswell (2009)	Athukorala (2009)	Burger et al. (2009)	Jongwanich (2009)	Miroudot and Ragoussis (2009)
Model											
Gravity Model	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Others										✓	
Dependent Variables											
Imports	✓					✓	✓				
Exports		✓	✓	✓	✓			✓	✓	✓	✓
Bilateral Trade Flows											
Other Variables					✓						✓
Independent Variables											
Demand and Supply Variables											
Partial Analysis											
GDP	+,+	+,+	x, +	+,+	-,x		x, +	+,+			
GDP/GNP per Capita		+,+			-,x			+,±		+,x	
Population	x,-			-,+							
Total Analysis											
Product of GDP/GNP						+					±
Product of GDP/GNP per Capita											
Export Specialisation							+				
Share of Intra-industry Trade				+							
Resource Endowment							+			+	
Relative Country Size											-
Difference in Relative Factor Endowment						±		-	±		
Other Macroeconomic Variables											
Price Instability										n	
Economic Crisis								±			
Political & Social Issues											
FDI											
Trade Facilitation	+				+					+	

Table C-1 (Continued)

	Carrère (2006)	Santos Silva and Tenreyro (2006)	Gebrehiwet et al. (2007)	Papazoglou (2007)	Nordås (2008)	Paas et al. (2008)	Anders and Caswell (2009)	Athukorala (2009)	Burger et al. (2009)	Jongwanich (2009)	Miroudot and Ragoussis (2009)
Geographic Variables											
Distance	-	-	-	-	-	-	-	-	-		-
Language		+							+		±
Common Border	+	+		+		+		+	+		+
Common Region				+			+			+	
Landlocked	-	-									
Transport Cost											
Important Policies & Institutional Variables											
Monetary Regime											
Nominal/Real Exchange Rates	-						+	+		+	
Exchange Rate Volatility											
Common Currency											
Foreign Currency Reserves											
Trade Policies											
Trade Openness/Trade Policy Regime		±								+	
Trade Agreements (e.g., FTAs)	±	+							+		
Food Safety & Standards (e.g., SPS and Import Refusals)			-				-			-	
Other Non-tariff Barriers											
Tariff Barriers					-						
Privilege Related Trade (e.g., GSP)											
Economic and Social Upgrading Variables											
Product Upgrading											
Process Upgrading										+	
Functional upgrading											
Inter-sectoral Upgrading											
Social Upgrading											+

Table C-1 (Continued)

	Carrère (2006)	Santos Silva & Tenreyro (2006)	Gebrehiwet et al. (2007)	Papazoglou (2007)	Nordås (2008)	Paas et al. (2008)	Anders and Caswell (2009)	Athukorala (2009)	Burger et al. (2009)	Jongwanich (2009)	Miroudot and Ragoussis (2009)
Country Analysis											
Multilateral Countries	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
A Specific Country							✓				
Product Analysis											
Aggregated Products	✓	✓			✓	✓			✓		
Disaggregated Products			✓		✓		✓	✓		✓	✓
Econometric Estimate Method											
OLS					✓				✓		
GLS/FGLS											
Pooled OLS	✓	✓	✓	✓							✓
Simultaneous Equations										✓	
Fixed Effect Approach	✓	✓				✓	✓			✓	
Dynamic Panel Data								✓			
PPML/GPML/NBPML		✓							✓		
Zero-Inflated Models									✓		
Time series Methods (e.g., VAR, Co-integration)											
Others (e.g., discreat models)											

Table C-1 (Continued)

	Nguyen and Wilson (2009)	Shepherd and Wilson (2009)	Akhter and Ghani (2010)	Baylis et al. (2010)	Bonnal (2010)	Devadason (2011)	Gul and Yasin (2011)	Athukorala (2012)	Brooks and Ferrarini (2012)	Jongwattanakul (2012)
Model										
Gravity Model	✓	✓	✓	✓		✓	✓	✓	✓	✓
Others					✓					
Dependent Variables										
Imports		✓						✓		✓
Exports	✓			✓		✓		✓		✓
Bilateral Trade Flows			✓				✓			
Other Variables					✓				✓	
Independent Variables										
Demand and Supply Variables										
Partial Analysis										
GDP	+,+					+,+				+,+
GDP/GNP per capita					-,x	+,+				
Population										
Total Analysis										
Product of GDP/GNP			+	+			+	+		
Product of GDP/GNP per Capita			+							
Export Specialisation				+						
Share of Intra-industry Trade										
Resource Endowment										
Relative Country Size										
Difference in Relative Factor Endowment							+			
Other Macroeconomic Variables										
Price Instability										
Economic Crisis								-		
Political & Social Issues										
FDI										
Trade Facilitation		+						±		

Table C-1 (Continued)

	Nguyen and Wilson (2009)	Shepherd and Wilson (2009)	Akhter and Ghani (2010)	Baylis et al. (2010)	Bonnal (2010)	Devadason (2011)	Gul and Yasin (2011)	Athukorala (2012)	Brooks and Ferrarini (2012)	Jongwattanakul (2012)
Geographic Variables										
Distance	-	-	-	-		-	-	-	-	-
Language	-	+		+			+	+		
Common Border	+	+	+	+			-			
Common Region	+									
Landlocked								±	-	
Transport Costs									-	
Important Policies & Institutional Variables										
Monetary Regime										
Nominal/Real Exchange Rates				-			+	±		
Exchange Rate Volatility										+
Common Currency										
Foreign Currency Reserves										
Trade Policies										
Trade Openness/Trade Policy Regime							+			
Trade Agreements (e.g., FTAs)			±					+	+	±
Food Safety & standards (e.g., SPS & Import Refusals)	-									
Other Non-tariff Barriers										
Tariff Barriers			-						-	
Privilege Related Trade (e.g., GSP)										
Economic & Social Upgrading Variables										
Product Upgrading										
Process Upgrading	+			±						
Functional Upgrading										
Inter-sectoral Upgrading										
Social Upgrading					+					

Table C-1 (Continued)

	Nguyen and Wilson (2009)	Shepherd and Wilson (2009)	Akhter and Ghani (2010)	Baylis et al. (2010)	Bonnal (2010)	Devadason (2011)	Gul and Yasin (2011)	Athukorala (2012)	Brooks and Ferrarini (2012)	Jongwattanakul (2012)
Country Analysis										
Multilateral Countries	✓	✓	✓	✓	✓	✓	✓	✓	✓	
A Specific Country										✓
Product Analysis										
Aggregated Products		✓	✓		✓		✓			
Disaggregated Products	✓			✓		✓		✓	✓	✓
Econometric Estimate Method										
OLS										
GLS/FGLS			✓							
Pooled OLS		✓	✓	✓				✓		
Simultaneous Equations										
Fixed Effect Approach	✓					✓	✓	✓	✓	✓
Dynamic Panel Data					✓					
PPML/GPML/NBPML									✓	✓
Zero-Inflated Models										
Time Series Methods (e.g., VAR, Co-integration)										
Others (e.g., discreat models)										

Table C-1 (Continued)

	Noguera (2012)	Tran et al. (2012)	Choi (2013)	Francois and Manchin (2013)	He et al. (2013)	Hua (2013)	Kareem (2013)	Tripathi and Leitão (2013)	Saslavsky and Shepherd (2014)	Philippidis et al. (2014)
Model										
Gravity Model	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Others										
Dependent Variables										
Imports		✓		✓	✓	✓				✓
Exports						✓	✓		✓	
Bilateral Trade Flows								✓		
Other Variables	✓		✓							
Independent Variables										
Demand & Supply Variables										
Partial Analysis										
GDP					+,+	+,+	+,+	+,+	+,+	
GDP/GNP per Capita										
Population							-,+			
Total Analysis										
Product of GDP/GNP			+							
Product of GDP/GNP per Capita										
Export Specialisation										
Share of Intra-industry Trade										
Resource Endowment			+							
Relative Country Size										
Difference in Relative Factor Endowment										±
Other Macroeconomic Variables										
Price Instability										
Economic Crisis										
Political & Social Issues						+		+		
FDI										
Trade Facilitations				+					+	

Table C-1 (Continued)

	Noguera (2012)	Tran et al. (2012)	Choi (2013)	Francois and Manchin (2013)	He et al. (2013)	Hua (2013)	Kareem (2013)	Tripathi and Leitão (2013)	Saslavsky and Shepherd (2014)	Philippidis et al. (2014)
Geographic Variables										
Distance	-	-	-	-			-	+	-	-
Language	+	±	+	+			n		+	±
Common Border	+	+	+					+	+	+
Common Region										
Landlocked						-	±			
Transport Costs										
Important Policies & institutional Variables										
Monetary Regime										
Nominal/Real Exchange Rates					+	+				
Exchange Rate Volatility										
Common Currency										
Foreign Currency Reserves										
Trade Policies										
Trade Openness/Trade Policy Regime										
Trade Agreements (e.g., FTAs)	+	+				±	+			±
Food Safety & Standards (e.g., SPS & Import Refusals)		-					-			
Other Non-tariff Barriers										
Tariff Barriers				-	-					
Privilege Related Trade (e.g., GSP)										
Economic & Social Upgrading Variables										
Product Upgrading					n					
Process Upgrading										
Functional Upgrading						+				
Inter-sectoral Upgrading										
Social Upgrading										

Table C-1 (Continued)

	Noguera (2012)	Tran et al. (2012)	Choi (2013)	Francois and Manchin (2013)	He et al. (2013)	Hua (2013)	Kareem (2013)	Tripathi and Leitão (2013)	Saslavsky and Shepherd (2014)	Philippidis et al. (2014)
Country Analysis										
Multilateral Countries	✓	✓	✓	✓			✓		✓	✓
A Specific Country					✓	✓		✓		
Product Analysis										
Aggregated Products			✓	✓		✓		✓		
Disaggregated Products	✓	✓			✓	✓	✓		✓	✓
Econometric Estimate Method										
OLS									✓	
GLS/FGLS							✓			
Pooled OLS		✓	✓				✓			
Simultaneous Equations										
Fixed Effect Approach	✓		✓		✓	✓	✓	✓		
Dynamic Panel Data								✓		
PPML/GPML/NBPML		✓	✓	✓			✓		✓	✓
Zero-Inflated Models		✓								✓
Time Series Methods (e.g., VAR, Co-integration)										
Others (e.g., discreat models)										

Table C-1 (Continued)

	Bensassi et al. (2015)	Jordaan (2015)	Lee (2015)	Ahmad et al. (2016)	Kareem et al. (2016)	Lin (2016)	Sahu (2016)	Thuong (2017)	Wood et al. (2017)	Metulini et al. (2018)	Türkcan and Saygili (2018)
Model											
Gravity Model	✓	✓	✓		✓	✓		✓	✓	✓	
Others				✓			✓				✓
Dependent Variables											
Imports			✓								
Exports	✓	✓		✓	✓	✓		✓	✓		✓
Bilateral Trade Flows										✓	
Other Variables							✓				
Independent Variables											
Demand & Supply Variables											
Partial Analysis											
GDP		±,-			+,+		+,x	-			x, ±
GDP/GNP per capita										+,+	
Population		x,±						n,+		+,+	
Total Analysis											
Product of GDP/GNP	+		+								
Product of GDP/GNP per Capita			-								
Export Specialisation									+		
Share of Intra-industry Trade											
Resource Endowment								+			
Relative Country Size											
Difference in Relative Factor Endowment									-		
Other Macroeconomic Variables											
Price Instability											
Economic Crisis											
Political & Social Issues											
FDI				+							
Trade Facilitations	+					-					

Table C-1 (Continued)

	Bensassi et al. (2015)	Jordaan (2015)	Lee (2015)	Ahmad et al. (2016)	Kareem et al. (2016)	Lin (2016)	Sahu (2016)	Thuong (2017)	Wood et al. (2017)	Metulini et al. (2018)	Türkcan and Saygili (2018)
Geographic Variables											
Distance	-		±		-				+	+	-
Language	+		+							-	±
Common Border	±									+	
Common Region											
Landlocked					-						
Transport Costs											
Important Policies & Institutional Variables											
Monetary Regime											
Nominal/Real Exchange Rate		±		+					-		
Exchange Rate Volatility											
Common Currency											
Foreign Currency Reserves											
Trade Policies											
Trade Openness/Trade Policy Regime				+							
Trade Agreements (e.g., FTAs)	+		+		+					+	±
Food Safety & Standards (e.g., SPS & Import Refusals)					n			-	+n		
Other Non-tariff Barriers											
Tariff Barriers								-n	-		
Privilege Related Trade (e.g., GSP)											
Economic & Social Upgrading Variables											
Product Upgrading			+								
Process Upgrading											
Functional Upgrading				+		+					
Inter-sectoral Upgrading											
Social Upgrading							+				

Table C-1 (Continued)

	Bensassi et al. (2015)	Jordaan (2015)	Lee (2015)	Ahmad et al. (2016)	Kareem et al. (2016)	Lin (2016)	Sahu (2016)	Thuong (2017)	Wood et al. (2017)	Metulini et al. (2018)	Türkcan and Saygili (2018)
Country Analysis											
Multilateral Countries		✓		✓	✓				✓	✓	
A Specific Country	✓		✓			✓		✓			✓
Product Analysis											✓
Aggregated Products	✓	✓		✓		✓				✓	
Disaggregated Products			✓		✓			✓	✓		
Econometric Estimate Method											
OLS				✓			✓				
GLS FGLS					✓			✓			
Pooled OLS			✓			✓		✓			
Simultaneous Equations											
Fixed Effect Approach	✓	✓			✓	✓		✓			
Dynamic Panel Data		✓									
PPML/GPML/NBPML			✓		✓	✓		✓	✓	✓	
Zero-Inflated Models								✓		✓	
Time Series Methods (e.g., VAR, Co-integration)											
Others (e.g., discreat models)											✓

Note: Signs of all independent variables are as follows:

1. + refers to the positive direction of the coefficient and statistical significance.
2. - refers to the negative direction of the coefficient and statistical significance.
3. n refers to an independent variable that is statistically insignificance.
4. x refers to the fact it is not in the equation.
5. The combination of signs refers to the combination of meanings from 1-3. Thus, we have three patterns: ±, +n, -n. For example, ± refers to an independent variable which has positive and negative coefficients with statistical significance.
6. When the signs are presented in a pair, the first sign belongs to an exporting country, and the second sign belongs to an importing country. For example, the pair of signs is +,x. This means that the exporting country's GDP has a positive coefficient and the importing country's GDP is not included in the analysis.

Source: Summarised from the literature

Appendix D

Sensitivity Test for Cut-off Points

Table D-1 Sensitivity Test for Cut-off Points

Criteria	Product categories									
	Total processed food		Processed shrimp		Processed chicken		Canned tuna		Canned pineapple	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
No	194	100	145	100	87	100	181	100	171	100
0.1%	61	95.42	24	97.80	16	99.66	63	96.04	59	97.11
0.2%	45	92.96	19	97.06	13	99.17	50	94.18	47	95.52
0.3%	34	90.28	17	96.51	13	99.17	44	92.76	41	94.01
0.4%	32	89.60	15	95.77	11	98.78	35	89.71	39	93.32
0.5%	28	87.74	15	95.77	11	98.78	32	88.32	37	92.40
0.6%	26	86.66	14	95.25	11	98.22	31	87.78	29	89.14
0.7%	22	84.10	12	93.94	11	98.22	29	86.51	28	87.14
0.8%	22	84.10	12	93.94	11	98.22	26	84.30	25	84.94
0.9%	21	83.20	11	93.07	9	96.55	23	81.69	23	83.26
1%	20	82.30	11	93.07	8	95.59	20	78.85	22	82.34

Note: (1) Remainder of Trading Partners

(2) Percentage of Export Values of the Remainder to Total Exports

Source: Author's computations from the Global Trade Atlas and the UN Comtrade database

Appendix E

Literature on the Key Determinants Influencing Economic and Social Upgrading

Table E-1 Literature on the Key Determinants Influencing Economic and Social Upgrading

	Feng (2001)	Martinez-Zarzoso and Nowak-Lehmann (2003)	Wilson et al. (2003)	Casacuberta et al. (2004)	Majid (2004)	Pacheco-López (2005)	Tang (2005)	Wilson et al. (2005)	Clarke and Wallsten (2006)
Dependent Variables									
Imports						✓			
Exports		✓	✓			✓	✓	✓	✓
Bilateral Trade Flows									
Economic Upgrading									
Social Upgrading				✓	✓				
Other Performance	✓					✓			
Key Factors (Explanatory Variables)									
Productive Capacities									
R&D									
Human Capital	+								
Infrastructure & Service									
Aggregated Index		+						+	
Individual Index									
Road Density									
Rail Density									
Airport Density									
Telephone Density									
Number of Internet Users									+n
Road Quality									
Port Efficiency			+						
Airport Quality									
Service Sector Infrastructure			+						
Specific Index									
LPI									

Table E-1 (Continued)

	Feng (2001)	Martinez-Zarzoso and Nowak-Lehmann (2003)	Wilson et al. (2003)	Casacuberta et al. (2004)	Majid (2004)	Pacheco-López (2005)	Tang (2005)	Wilson et al. (2005)	Clarke and Wallsten (2006)
Business Environment									
Aggregated Index									
Individual Index									
Corruption Index								+	
Political Stability	+								
Regulatory Environment			-						
Institution Index									
Irregular Payments									
Custom Environment			+						
Financial Development									
Price Instability									
Exchange Rate Volatility							-		
Trade & Investment Policies									
Trade Policy Regimes (e.g., Trade Openness Index)					±				
Trade Liberalisation									
Reducing Tariff Variables				±					
FTA/PTA Variables									
Other Variables						+			
Other Trade Privileges									
GSP									
SEZ Programme									
Industry Institutionalisation									

Table E-1 (Continued)

	Feng (2001)	Martinez-Zarzoso and Nowak-Lehmann (2003)	Wilson et al. (2003)	Casacuberta et al. (2004)	Majid (2004)	Pacheco-López (2005)	Tang (2005)	Wilson et al. (2005)	Clarke and Wallsten (2006)
Level Analysis									
Country-level	✓	✓	✓		✓	✓	✓	✓	✓
Firm-level				✓					
Data Characteristics									
Cross-sectional Data	✓								✓
Time Series Data						✓			
Panel Data		✓	✓	✓	✓		✓	✓	
Econometric Specifications									
OLS	✓								✓
WLS/GLS/FGLS									
GMM				✓					
Instrumental Variable Technique				✓					
Pooled OLS		✓	✓	✓	✓		✓	✓	
Fixed & Random Effects Approaches		✓				✓		✓	
Qualitative Response Regression Models (e.g., Logit & Probit Models)									
Modified Count Models (e.g., Poisson and Family and Zero-Inflated Models)									
Time Series Models (e.g., Cointegration & ECM, VAR, ARDL)						✓			
Simultaneous Equations							✓		

Table E-1 (Continued)

	Nordås (2008)	Bojnec and Fertö (2009)	Jongwanich (2009)	Jongwanich and Magtibay-Ramos (2009)	Kayam (2009)	Miroudot and Ragoussis (2009)	Shepherd and Wilson (2009)	Akhter and Ghani (2010)	Musila and Sigue´ (2010)
Dependent Variables									
Imports							✓		
Exports	✓	✓	✓	✓		✓			✓
Bilateral Trade Flows								✓	
Economic Upgrading					✓				
Social Upgrading									
Other Performance	✓								
Key Factors (Explanatory Variables)									
Productive Capacities									
R&D									
Human Capital						+			
Infrastructure & Service									
Aggregated Index	+								
Individual Index									
Road Density	+		n	+					
Rail Density	+								
Airport Density	+								
Telephone Density	+								
Number of Internet Users		+n							
Road Quality	+								
Port Efficiency	+								
Airport Quality							+		
Service Sector Infrastructure							+		
Specific Index									
LPI									

Table E-1 (Continued)

	Nordås (2008)	Bojnec and Fertö (2009)	Jongwanich (2009)	Jongwanich and Magtibay-Ramos (2009)	Kayam (2009)	Miroudot and Ragoussis (2009)	Shepherd and Wilson (2009)	Akhter and Ghani (2010)	Musila and Sigue´ (2010)
Business Environment									
Aggregated Index									
Individual Index									
Corruption Index	+								+
Political Stability					-n				
Regulatory Environment									
Institution Index									
Irregular Payments							n		
Custom Environment									
Financial Development			+	+					
Price Instability			n	+					
Exchange Rate Volatility									
Trade & Investment Policies									
Trade Policy Regimes (e.g., Trade Openness Index)			+	+					
Trade Liberalisation									
Reducing Tariff Variables									
FTA/PTA Variables		±						±	
Other Variables									
Other Trade Privileges									
GSP									
SEZ Programme									
Industry Institutionalisation									

Table E-1 (Continued)

	Nordås (2008)	Bojnec and Fertö (2009)	Jongwanich (2009)	Jongwanich and Magtibay-Ramos (2009)	Kayam (2009)	Miroudot and Ragoussis (2009)	Shepherd and Wilson (2009)	Akhter and Ghani (2010)	Musila and Sigue´ (2010)
Level Analysis									
Country-level	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firm-level									
Data Characteristics									
Cross-sectional Data	✓	✓							
Time Series Data									
Panel Data		✓	✓	✓	✓	✓	✓	✓	✓
Econometric Specifications									
OLS	✓	✓							
WLS/GLS/FGLS								✓	✓
GMM									
Instrumental Variable Technique									
Pooled OLS							✓	✓	
Fixed & Random Effects Approaches		✓	✓	✓	✓	✓			
Qualitative Response Regression Models (e.g., Logit & Probit Models)									
Modified Count Models (e.g., Poisson and Family and Zero-Inflated Models)									
Time Series Models (e.g., Cointegration & ECM, VAR, ARDL)									
Simultaneous Equations				✓					

Table E-1 (Continued)

	Pagano and Pica (2010)	Busse and Hefeker (2011)	Gul and Yasin (2011)	Jong and Bogmans (2011)	Athukorala (2012)	Bogliacino et al. (2012)	Brooks and Ferrarini (2012)	Buchanan et al. (2012)	Horsewood and Voicu (2012)
Dependent Variables									
Imports									
Exports			✓	✓					✓
Bilateral Trade Flows					✓				
Economic Upgrading									
Social Upgrading	✓					✓			
Other Performance		✓					✓	✓	
Key Factors (Explanatory Variables)									
Productive Capacities									
R&D						+			
Human Capital									
Infrastructure & Service									
Aggregated Index									
Individual Index									
Road Density									
Rail Density									
Airport Density									
Telephone Density									
Number of Internet Users									
Road Quality									
Port Efficiency									
Airport Quality									
Service Sector Infrastructure									
Specific Index									
LPI					±				

Table E-1 (Continued)

	Pagano and Pica (2010)	Busse and Hefeker (2011)	Gul and Yasin (2011)	Jong and Bogmans (2011)	Athukorala (2012)	Bogliacino et al. (2012)	Brooks and Ferrarini (2012)	Buchanan et al. (2012)	Horsewood and Voicu (2012)
Business Environment									
Aggregated Index								+	
Individual Index									
Corruption Index		n		+					+
Political Stability		+							
Regulatory Environment		+							
Institution Index		+							
Irregular Payments									
Custom Environment									
Financial Development	-n								
Price Instability									
Exchange Rate Volatility									
Trade & Investment Policies									
Trade Policy Regimes (e.g., Trade Openness Index)			+						
Trade Liberalisation									
Reducing Tariff Variables									
FTA/PTA Variables							+		
Other Variables									
Other Trade Privileges									
GSP									
SEZ Programme									
Industry Institutionalisation									

Table E-1 (Continued)

	Pagano and Pica (2010)	Busse and Hefeker (2011)	Gul and Yasin (2011)	Jong and Bogmans (2011)	Athukorala (2012)	Bogliacino et al. (2012)	Brooks and Ferrarini (2012)	Buchanan et al. (2012)	Horsewood and Voicu (2012)
Level Analysis									
Country-level	✓	✓	✓	✓	✓	✓	✓	✓	✓
Firm-level									
Data Characteristics									
Cross-sectional Data				✓					
Time Series Data									
Panel Data	✓	✓	✓		✓	✓	✓	✓	✓
Econometric Specifications									
OLS									
WLS/GLS/FGLS									
GMM		✓							
Instrumental Variable Technique								✓	
Pooled OLS				✓	✓	✓		✓	✓
Fixed & Random Effects Approaches	✓	✓	✓		✓	✓	✓	✓	
Qualitative Response Regression Models (e.g., Logit & Probit Models)									
Modified Count Models (e.g., Poisson and Family and Zero-Inflated Models)							✓		
Time Series Models (e.g., Cointegration & ECM, VAR, ARDL)									
Simultaneous Equations									

Table E-1 (Continued)

	Jongwattanakul (2012)	Portugal-Perez and Wilson (2012)	Chen and Yang (2013)	Ghafoor et al. (2013)	Jerzmanowski and Nabar (2013)	Manova (2013)	Mahutga (2014)	Philippidis et al. (2014)
Dependent Variables								
Imports	✓							✓
Exports	✓	✓		✓		✓	✓	
Bilateral Trade Flows								
Economic Upgrading			✓					
Social Upgrading					✓			
Other Performance								
Key Factors (Explanatory Variables)								
Productive Capacities								
R&D			+					
Human Capital						+	n	
Infrastructure & Service								
Aggregated Index		+						
Individual Index								
Road Density				+				
Rail Density								
Airport Density								
Telephone Density								
Number of Internet Users								
Road Quality								
Port Efficiency								
Airport Quality								
Service Sector Infrastructure								
Specific Index								
LPI								

Table E-1 (Continued)

	Jongwattanakul (2012)	Portugal-Perez and Wilson (2012)	Chen and Yang (2013)	Ghafoor et al. (2013)	Jerzmanowski and Nabar (2013)	Manova (2013)	Mahutga (2014)	Philippidis et al. (2014)
Business Environment								
Aggregated Index		+						
Individual Index								
Corruption Index								
Political Stability								
Regulatory Environment								
Institution Index								
Irregular Payments								
Custom Environment								
Financial Development					+n	+		
Price Instability								
Exchange Rate Volatility								
Trade & Investment Policies								
Trade Policy Regimes (e.g., Trade Openness Index)							+	
Trade Liberalisation								
Reducing Tariff Variables								
FTA/PTA Variables	±							±
Other Variables								
Other Trade Privileges								
GSP								
SEZ Programme								
Industry Institutionalisation								

Table E-1 (Continued)

	Jongwattanakul (2012)	Portugal-Perez and Wilson (2012)	Chen & Yang (2013)	Ghafoor et al. (2013)	Jerzmanowski and Nabar (2013)	Manova (2013)	Mahutga (2014)	Philippidis et al. (2014)
Level Analysis								
Country-level	✓	✓		✓		✓	✓	✓
Firm-level			✓		✓			
Data Characteristics								
Cross-sectional Data			✓					
Time Series Data				✓				
Panel Data	✓	✓			✓	✓	✓	✓
Econometric Specifications								
OLS								
WLS/GLS/FGLS								
GMM								
Instrumental Variable Technique								
Pooled OLS		✓						
Fixed & Random Effects Approaches	✓				✓	✓	✓	
Qualitative Response Regression Models (e.g., Logit & Probit Models)			✓			✓		
Modified Count Models (e.g., Poisson and Family and Zero-Inflated Models)	✓	✓						✓
Time Series Models (e.g., Cointegration & ECM, VAR, ARDL)				✓				
Simultaneous Equations								

Table E-1 (Continued)

	Sandu and Ciocanel (2014)	Saslavsky and Shepherd (2014)	Ge et al. (2015)	Klimek (2015)	Sahu (2016)	Tejani and Milberg (2016)	Ali (2017)	Lin (2017)	Fosu and Abass (2019)
Dependent Variables									
Imports									
Exports	✓	✓			✓		✓	✓	✓
Bilateral Trade Flows									
Economic Upgrading			✓	✓					
Social Upgrading						✓			
Other Performance									
Key Factors (Explanatory Variables)									
Productive Capacities									
R&D	+		+						
Human Capital					+		n		-n
Infrastructure & Service									
Aggregated Index									
Individual Index									
Road Density									
Rail Density									
Airport Density									
Telephone Density									n
Number of Internet Users									
Road Quality									
Port Efficiency									
Airport Quality									
Service Sector Infrastructure									
Specific Index									
LPI		+							

Table E-1 (Continued)

	Sandu and Ciocanel (2014)	Saslavsky and Shepherd (2014)	Ge et al. (2015)	Klimek (2015)	Sahu (2016)	Tejani and Milberg (2016)	Ali (2017)	Lin (2017)	Fosu and Abass (2019)
Business Environment									
Aggregated Index									
Individual Index									
Corruption Index									
Political Stability				-n					
Regulatory Environment				+					
Institution Index									
Irregular Payments									
Custom Environment									
Financial Development								+	-
Price Instability									
Exchange Rate Volatility									
Trade & Investment Policies									
Trade Policy Regimes (e.g., Trade Openness Index)						+	+n		+n
Trade Liberalisation									
Reducing Tariff Variables									
FTA/PTA Variables									
Other Variables									
Other Trade Privileges									
GSP									
SEZ Programme									
Industry Institutionalisation									

Table E-1 (Continued)

	Sandu and Ciocanel (2014)	Saslavsky and Shepherd (2014)	Ge et al. (2015)	Klimek (2015)	Sahu (2016)	Tejani and Milberg (2016)	Ali (2017)	Lin (2017)	Fosu and Abass (2019)
Level Analysis									
Country-level	✓	✓		✓	✓	✓	✓		✓
Firm-level			✓					✓	
Data Characteristics									
Cross-sectional Data				✓	✓			✓	
Time Series Data									
Panel Data	✓	✓	✓			✓	✓		✓
Econometric Specifications									
OLS				✓	✓			✓	
WLS/GLS/FGLS									
GMM							✓		✓
Instrumental Variable Technique									
Pooled OLS		✓				✓			
Fixed & Random Effects Approaches	✓		✓			✓			
Qualitative Response Regression Models (e.g., Logit & Probit Models)									
Modified Count Models (e.g., Poisson and Family and Zero-Inflated Models)		✓							
Time Series Models (e.g., Cointegration & ECM, VAR, ARDL)									
Simultaneous Equations									

Note: Signs of all independent variables are as follows:

1. + refers to the positive direction of the coefficient and statistical significance.

2. - refers to the negative direction of the coefficient and statistical significance.

3. n refers to an independent variable that is statistically insignificant.

4. The combination of the signs refers to the combination of meanings from 1-3. Thus, we have three patterns: ±, +n, -n. For example, ± refers to an independent variable that has both positive and negative coefficients with statistical significance.

Source: Summarised from the literature

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